WHAT'S IN THIS ISSUE

NOVEMBER

DEPARTMENTS

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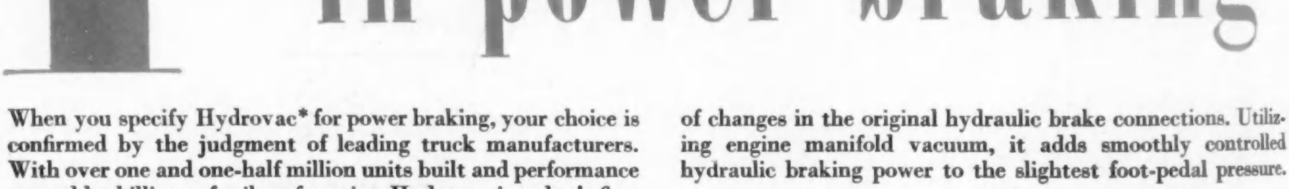

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AUTOMOTIVE ENGINEERING . . . . BRIGHTENS FARM OUTLOOK . .

by FOWLER McCORMICK

EIGHTEEN years ago I remember saying to some implement manufacturing executives of our company: "It's high time we stopped thinking and talking of ourselves as an implement company."

Our industry was fast becoming an automotive industry. I felt it important that we begin to think of ourselves in automotive engineering terms for two reasons:

- It would influence us to think about our design and manufacturing methods in more precise terms, and
- The engine, instead of the horse, was going to become the prime mover of farm equipment.

Even before that time, automotive engineering had begun to exert a broad influence on the farm equipment industry. The SAE had interested itself in the tractor as far back as 1916. Through the years, automotive engineers continued increasingly to concern themselves with agricultural equipment.

Pioneers of our industry did a perfectly grand job, but automotive engineering introduced improved techniques and engineering standards which have proved to be of great use in our industry. Today there is no hard and fast – or even a definite – line between the engineering concepts of the farm equipment industry on the one hand, and the automotive industry on the other.

It was not so long ago that engineers in our industry began to build their equipment around a powerplant and power train. Tools and equipment were being hung onto the motive power instead of being designed to be pulled by horses.

An important achievement of the automotive industry, as far as the farm implement and equipment industry is concerned, is building smaller powerplants. A comparison of a tractor of 30 or 40 years ago with one of the same power today is striking evidence of this trend. Smaller and lighter power trains are the rule rather than the exception.

Back of this achievement lies a wealth of automotive engineering experience in building automobiles and trucks. Smaller sections, better and lighter steels, the introduction of antifriction bearings, and development of rubber tire design have all played an important part in giving the farmer of today a better tractor for his money.

It would be a pretty discerning visitor who could tell the difference between a car or truck service station and a tractor service station of today. Compare such a tractor service station with the blacksmith shop of not very long ago. These are only

* SAE National Tractor Meeting Dinner, Milwaukee, Sept. 12, 1946.

Fowler McCormick
Chairman of the Board
International Harvester Co.

Clouds and Brightspots on Agricultural Horizon

I would like to say that the weather for the farmer in each of the 10 sectors of the horizon is clear, but that is not the truth.

Three of these are clouded pretty heavily. They are:

1. Increased acreage under cultivation in face of a falling demand during the next two years will lower the farmer's gross income;

2. Costs of feedstuffs, materials, services, and manufactured goods are rising, and will increase further, and

3. Farm labor is getting more scarce, and farmhand wages are rising.

Great optimism is to be derived from the other seven sectors of the agricultural horizon. They are:

1. Farmers have organized good cooperatives, which permit them to sell and buy at greater advantage;

2. Good Government representation has been established by the farmers in the interest of their welfare;

3. Chemurgy opens a vista of demand for raw materials for industry which will be produced on farms;

4. Government agencies and agricultural colleges have worked with farmers to improve soil and crop practices;

5. Never in the history of our country has there been a higher grade of livestock on ranches and farms. The Government, colleges, schools, and the 4-H clubs have been doing wonder work;

6. Farmers are living in better homes, have better farm buildings, and the use of electricity is increasing greatly on farms, and

7. Our industries are capable of producing better farm machinery at the lowest possible cost to help the farmer increase the farm's productivity.

a few examples of the debt our industry and the farmer owe to the vast automotive industry of America.

Better tractors and better farm machinery and implements are one of the brightest spots on the farmer's horizon. We of our industry are confident that we can further brighten this sector of the farmer's horizon, but we can't simply go into a room and sit comfortably and dream the thing out.

In the first place, we must find out what the farmer needs. We must study his problems in connection with producing more crops per acre with less and less manpower. We must analyze his problems from his point of view, just as design and production engineers of the automotive industry study the needs of truck and bus fleet operators in projecting their research and development programs and projects.

It seems to me that these are the reasonable expectations farmers have of our industry. They may sound trite, but they will be difficult to achieve:

- Lower first cost of product;
- Lower operating costs;
- Reduced maintenance costs;
- Improved starting and lighting equipment;
- Better power-lift and other accessory devices to speed up farm work and increase agricultural output, and
- Constantly improved rubber tires.

We must produce tractors and equipment more cheaply and at the same time give the farmer better machinery. That is a challenge to the best engineering brains of the farm equipment and automotive industries. It won't be easy to add to the value of equipment and to keep the costs down while this is being done.

Tractors and implements must always perform better work. For example, the corn picker and harvester must lose less grain in the field. Cultivators must destroy fewer growing crops. Combines must leave less behind.

Farm machines must be easier to operate. They must be more comfortable to ride and to work with. Engineers must design tools which can be more quickly hooked on and detached.

If our machines are to save manpower, these are important points. Truck and bus designers are under great pressure these days to make the working hours of the drivers more comfortable. Our engineers must do the same for farmers. We must make our products safer to operate.

Tremendous strides have been made by the automotive industry in improving appearance of the passenger cars, trucks, and buses. I think everyone will agree that this has had a marked effect on total sales. I think our industry has found it profitable to a considerable extent to make farm machinery and equipment more attractive.

Some of these design problems are, as in the automotive industry, strictly competitive. But, as in your Society's own experience, many engineering projects to help brighten the horizon of America's farmer can best be done through cooperative research. You have on your agenda today a number of interesting coordinated research programs in the tractor and farm equipment field. I wish your committees and their members all possible success in the work the SAE is doing on mud traction, flame arresters, tire and wheel simplification, and other work undertaken by the SAE Tractor and Farm Equipment committees.

Back of this is the cooperative work on better steels, better non-ferrous materials and studies of their physical properties, improved powerplants, and the coordinated studies on fuels and lubricants.

It is, of course, the professional livelihood of the engineer to keep his eyes on the horizon. There is justifiable pride in personal, staff, and corporate achievement. But beyond this, I think these things are worth doing because I believe there is no group of American citizens of more value to our country than the Farmers of America.

Theme: Productivity Boost

Cleveland Section Chairman John R. Cox, left, with Charles J. Stilwell, dinner speaker at the SAE National Production Meeting, Cleveland, Oct. 14. Mr. Stilwell is president of Warner & Swasey Co.

John E. Hacker, member of the National Production Meeting General Committee, with SAE President L. Ray Buckendale

Stephen Johnson, Jr., General Committee chairman, with SAE Past-President A. T. Colwell who aided the committee by inviting Mr. Stilwell to speak at the dinner

PRODUCTION engineers must share with management the task of replanting into the minds of American labor the idea that work, not Government doles, is their only hope of economic security. This was the theme of discussions at both technical sessions and the keynote of the banquet speech which closed the one-day SAE National Production Engineering Meeting in Cleveland, Oct. 14.

Crux of many production engineering developments at hand and in prospect is the growing laxity of labor, and a number of executive engineers saw themselves balked, despite large expenditures in equipment, in further taking the backbreak out of production of mechanical products.

Pointing out that his audience was composed of men on their way up to top management or production engineering posts in the automotive industry, Charles J. Stilwell, president of Warner & Swasey Co., warned that they would reach their goals in their careers only if the American concept of free enterprise lived. His evidence, and the gripping testimony heard at the preceding technical sessions, showed that today's major industrial task is to overcome the human limitations that hamper production.

Throughout the meeting in the Carter Hotel this studied opinion prevailed:

None of the production management programs and research achievements reported at the meeting can lift the production level of American industry unless workers are reinspired to work.

Nearly 400 production engineers and manufacturing executives from a score of states attended the first postwar production meeting of the Society, staged under the general chairmanship of Stephen Johnson, Jr., chairman of the SAE Production Engineering Activity Meetings Committee. His associates were J. E. Hacker, production manager of the Cleveland Diesel Division, General Motors

Corp., and John R. Cox, president, Balas Collet Co.

The day's program started with an incisive investigation of troubles with today's grey iron casting output. This was followed by a report of an exhaustive research project on grinding, and the other on management control through industrial engineering closed the technical phase of the meeting.

Despite the subjects, growing laxity of workers punctuated the discussions throughout the day although session chairmen attempted to hold remarks from the floor on a strictly engineering plane. Corridors buzzed with example upon example of what some called deliberate sabotage against the production engineer and factory management.

A. A. Weidman, who has been responsible for the purchase and approval of millions of dollars worth of castings for the Detroit Diesel Division of General Motors Corp., held that the responsibility for rejections lies partly at the door of the design engineer, purchasing agents share in the blame for squeezing prices down, careless foundry personnel, and also management on both sides of the fence.

Likening the problem to that of two noisy cats yeowling on a back fence, he showed charts depicting steady reductions of rejects as soon as the user and producer got together. The two cats, he observed, were not biologically incompatible in the first place – and he pointed out that the machine fabricator and foundry were on the same fence and yelling at each other was of no avail.

Among the oldest crafts known to primitive man, iron casting is in need of a great deal of improvement for today's exacting requirements. Improvement only requires:

- Consultation of designers with foundry experts *before* the part is designed;
- More liberality in price extended by the purchasing department to permit foundries to operate at a reasonable profit;
- More flexibility in the machine shop to handle occasional misruns, and
- Better understanding of the shop's castings requirement by the shop's own inspectors.

To help themselves stay in business, on the other hand, foundries must:

- Modernize their plants with labor saving equipment and take advantage of developments in automatic foundry devices;
- Promote an educational program to make the public, and hence prospective workers, recognize the importance of foundries in today's industries;
- Plan and execute sound apprentice training programs, and
- Improve foundry working conditions by cleaning them up, providing better ventilation, cafeterias for workers, and adding a graduate and experienced engineer to their payrolls.

Discussion brought out numerous examples which buttressed Mr. Weidman's conclusions. In answer to a question the speaker said that foundries operated by larger automotive companies have the benefit of coordination between the design and the casting, and general engineering supervision. But, he said, foundries could avail themselves of this engineering service by pooling their own problems among themselves. He said that many user plants would cooperate on technical questions.

An organization of foundries is moving along this line, another speaker said. He felt that meetings such as this were most constructive.

Mr. Weidman raised the need for nomenclature for castings and their conditions, and suggested SAE action. SAE President L. Ray Buckendale took the floor and explained the setup and functions of the SAE Technical Board which was, he said, established to handle such problems as this. He invited a request to develop an SAE nomenclature of grey iron casting terms. This he reiterated at the banquet, after outlining the extensive range of coordinated technical projects being developed under the aegis of the SAE Technical Board.

Additives cannot be relied upon to improve good castings unless careful control is exercised, the speaker said in answer to another question. This led to a vigorous discussion of the need of control of foundry procedure.

When laxity of labor was introduced as an element of major importance, the discussion was channeled into the subject of improved instrumentation. The consensus appeared to be that foundry management must be convinced of the value of instrumentation, a situation which apparently seldom exists. Too many heats are poured into molds despite the fact that tests showed the molten metal was valueless except for scrap for remelting.

A new approach to cylindrical grinding research was presented by R. E. McKee and Prof. O. W. Boston, University of Michigan, and R. S. Moore, Quaker Chemical Products Corp. They showed, by exhaustive tests of one SAE steel and a single grinding fluid the effects of speed, wheel grit size, and relative concentrations of fluid that predeterminations of surface finishes could be made.

Engineers at the session freely predicted that this study would become known as a milestone in production research in that it set up a reproducible test method which could be used on other steels and with other compounds and other types of cylindrical grinding wheels.

A report on Management Controls Through Industrial Engineering focused attention of the

continued on page 112

WHICH Driver for the Job?

Fig. 1 – Depth perception and visual acuity, extremely important factors in safe vehicle operation, are checked on this testing device. It is one of a group of special devices now widely used to help employment managers discover physical or sensory limitations of an applicant for a driving job. (Test designed by American Automobile Association)

Excerpts from Paper by **Prof. Amos E. Neyhart***

EMPLOYERS of drivers today have the opportunity of a lifetime to "screen out" applicants and appraise the man as a permanent asset to the business. This was not true during the past five years. During the war, management was forced to employ many incompetents as drivers. If there were openings for 10 men, five would apply. There was no choice; wheels must roll.

Motor truck fleet operators generally are coming to recognize the value of a good driver selecting and training program. No longer do they accept claimed years of driving experience or the mere holding of an operator's license as evidence that its possessor is a skilled driver, or a good employee – one to be entrusted with an expensive vehicle, a valuable cargo and the owner's reputation.

However, this problem of selecting and training drivers is far from simple. Various methods have been tried. Some fleet operators have believed that bonuses or other award plans will improve driving to such an extent that training or re-training is unnecessary. *If a driver does not know how to drive in a competent, safe way, the mere offering of bonuses or other awards will not teach him.* Time must be spent on developing good driving habits, if good results are to be expected.

Why Train Drivers?

The tendency too often has been to confine the selecting program simply to hiring drivers who pointed to their long experience as evidence of being highly skilled. Management apparently believed that, under such circumstances, training would be reduced or be unnecessary. Trying to secure only seasoned men and letting "the other fellow" do the training has contributed to the present dearth of good drivers. How different is this procedure from that in other industrial fields! Selecting and training of men for production jobs is generally accepted as essential to filling the job satisfactorily. When it comes to driving, however, it is so easy to stumble into that old pitfall of assuming that the driver with 10 years of driving experience surely is well qualified.

Sixteen procedures and materials *for finding the*

*Paper by Prof. Amos E. Neyhart, administrative head, Institute of Public Safety, Pennsylvania State College, was presented at SAE Summer Meeting on June 3, 1946.

Fig. 2—Interior of test shown in Fig. 1. The ability to judge distance is measured by lining up the toy automobiles side by side and recording the error. The use of a mirror at a distance of 10 ft gives an apparent distance to the cars of 20 ft. The Snellen chart letters, mounted on a revolving wheel, are in reverse, to be read through the mirror

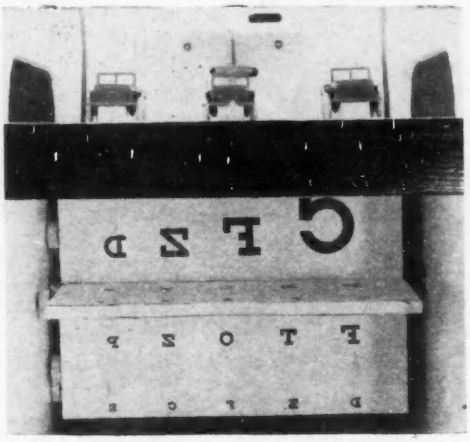


Fig. 3 (right) — Accident-free driving requires concentration and ability to react quickly in tough traffic situations. This Simple Reaction Time test is portable. It measures the time required to step on the brake in hundredths of a second. (Test designed by American Automobile Association)

right man for the driving job are utilized by far-sighted management today. While the small operator cannot, obviously, take the time to utilize all these "tools of selecting," there are certain items he should consider fundamental, adding to his selecting procedure other items as he is able.

1. *Job Analysis and Specification.* What the requirements of the job are, down in black and white, is essential – as well as the type of person desired to fill it satisfactorily. The two terms, *Job Analysis* and *Job Specification,* represent scientific attempts to "break down" into its elements each important part of the job and the human qualifications necessary for effective performance.

Five methods may be used to make the job analysis. (1) A carefully developed questionnaire may be sent to all employees who have not attained executive positions. (2) Necessary information may be secured through a series of committees. (3) A representative of the personnel office might make ordinary observation of the job. (4) Good and poor worker groups might be selected and comparison made of the characteristics of each group. (5) Lastly, the best, careful study of the job may be made by a trained job analyst, who ordinarily would be a member of the Personnel or Industrial Engineering Department.

Following the analysis, a *job specification* is formulated and used in the driver selecting program.

2. *Application Blank.* In addition to the usual information desired, it should seek data on education, driving and accident experience (number of convictions for traffic and other violations), and no-accident awards received. A part of the blank should provide space for the interviewer to give his estimation of the applicant, as well as the results of the mental, physical, emotional, knowledge, driving skill, traffic and attitude tests given.

3. *The Interview.* The applicant should be given an unhurried opportunity to do most of the talking in presenting his own case. The job should not be over-sold, the applicant seeking the work, if possible, so that he may form his own estimate of it.

4. *Selected References.* While little reliance is placed today upon references, the applicant should be asked for both personal and business references. This should be verified by telephone or personal visit to previous employers, if possible. Without verification, references are next to useless.

5. *Physical Examinations.* For bus and truck operators coming under its jurisdiction, ICC Motor

Fig. 4—Field of Vision driver testing device, widely used to weed out persons with restricted side or "barrel" vision. Ability to see to the sides is extremely important in driving. (Test designed by American Automobile Association)

Fig. 5 – Ability to see in dim light and also in the face of glaring headlights is measured by this AAA glare-acuity testing device

Fig. 6 – This steadiness test determines if a driver is physically up to par. It measures the degree of steadiness as the hand moves a stylus downward between two metal strips which gradually become closer together. Graduations along one side indicate the score, the light flashing when the stylus touches either metal strip. (Test designed by American Automobile Association)

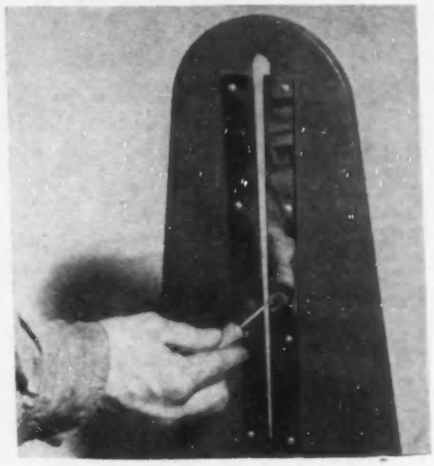


Fig. 7 – Layout for street car or off-street area used for giving six driving skill tests. Measurements are for vehicles of about eight feet in width, such as trucks, buses, and other large vehicles, excluding tractor-trailer units. A layout also is available for testing drivers of passenger cars, which in some cases form a large part of the fleet

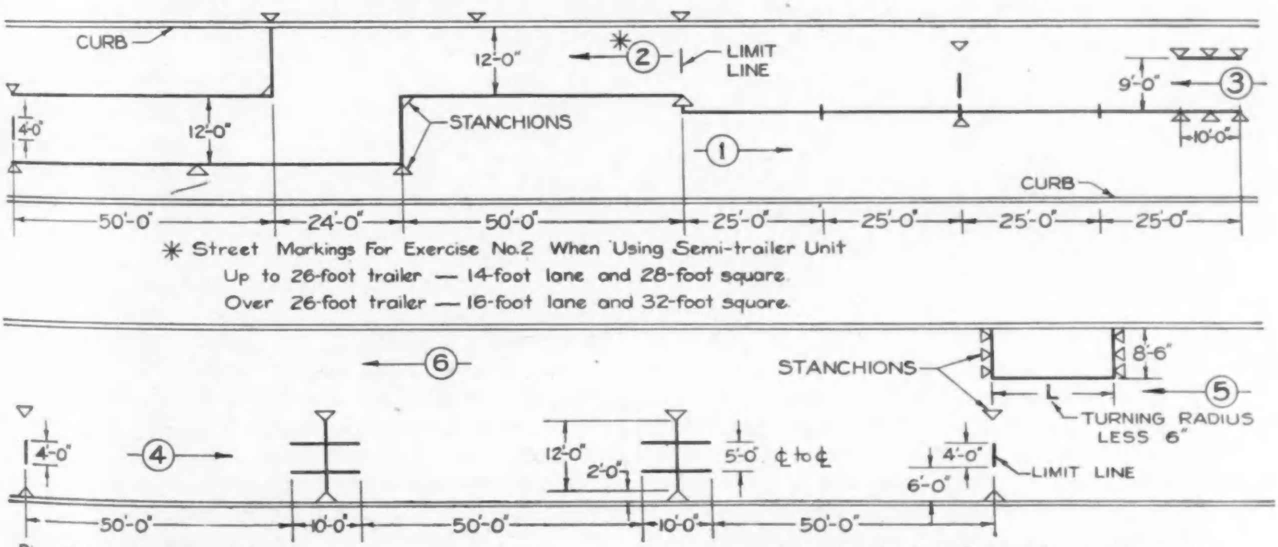
STREET MARKINGS FOR SKILL-DEVELOPING EXERCISES

Recommended Skill-Developing Exercises

1. Straight Line – Forward and Backward (100 feet).
2. Gauging Space – When Steering In Close Limits.
3. Smooth Stopping – In 40 feet at 20 m.p.h.
4. Front and Back Limits – Wheels and Bumpers.
5. Parallel Parking – Backing In and Pulling Out.
6. Measuring Thinking and Braking Distance.

MARKINGS FOR EXERCISES 1 TO 6 – MOTOR VEHICLES OF ABOUT EIGHT FOOT WIDTH.

(Trucks, Busses, and Other Large Vehicles Excluding Tractor-Trailer Units)



Dimensions are to center of lines.
Lines are all 4" wide
All limit lines are 4'-0" long.
All stanchions are placed 12'-0" apart at limit lines.
Numbers in circles indicate markings for that particular exercise.

Arrows on circles show direction of vehicle for each exercise.
No markings should be closer than 100 feet to an intersection
Ten stanchions are required to conduct exercises.
Exercise markings should be spaced according to length of street – not crowded.

Fig. 8—Driving skill tests Nos. 1 and 2. On this driver testing area at New York Navy Yard, the driver of the car at right is taking the straight line "steering" test along a 100-ft line. Score is determined after he drives both forward and backward attempting to keep left wheels on the line. The "gauging space" test is shown at left. The driver is required to steer and maneuver his vehicle both forward and backward quickly and accurately through an "S" marked lane. Score is determined by elapsed time and number of stanchions and white lines touched

Fig. 9—Driving skill test No. 3. Running between stanchions at 20 mph with only 6 in. clearance on each side, the driver is required to stop smoothly within 40 ft with his front bumper over a white line. He is instructed to start to apply the foot brake as the front bumper passes between the first pair of stanchions

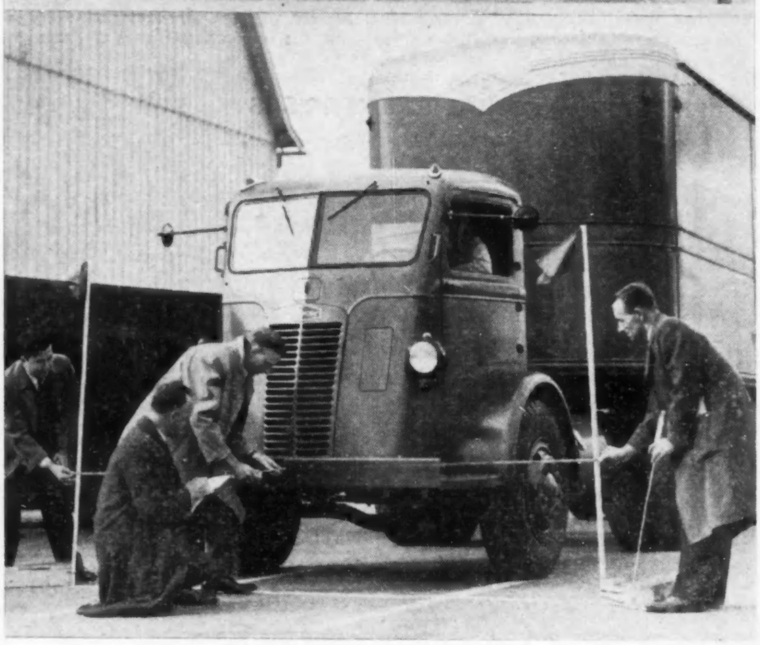


Fig. 10—Driving skill test No. 4. This test is to determine whether the driver knows the location of front and rear wheels, and front and rear extremities of the vehicle. After moving forward at slow speed he is required to stop, first with front left tire over a white line; then, with bumper lined up with stanchions; (shown in photograph) then, with rear bumper over white limit line. Having the driver demonstrate his skill can be very effective in creating the right attitude toward proper operation of his vehicle

Carrier Regulations require a physical examination by a physician for all new drivers. ICC also requires that motor carriers must have on file a certificate showing each new driver to be physically qualified. It is good practice to re-examine all drivers where observation indicates that deficiencies possibly have developed.

6. *General Intelligence Test and Check for Mental Characteristics.* This helps management to obtain an indication of the type and level of work the applicant eventually will be able to handle – whether he is too smart, or not smart enough; too fast, or not fast enough, for a particular job. Such traits as excitability, alertness, worriedness, abnormal characteristics, self-confidence and resistance to distraction should be checked.

7. *The Personality Inventory.* For fleet operation, enforcement work, or other positions where the employee contacts the public and the customer, management must have a vital interest in his personality, because *he is the company* when making daily contacts. Tests which show up belligerent and morose personalities are very useful to the company which values its public relations position.

8. *Vocational Interest Blank.* This is used to check adaptability to basic work by means of simi-

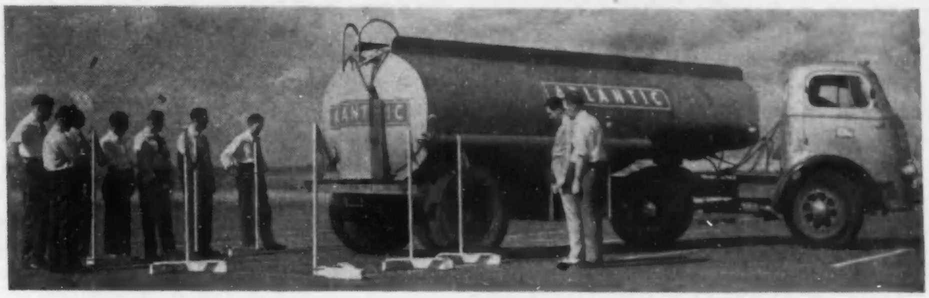


Fig. 11—Driving skill test No. 5. Parking large vehicles safely and properly is a valuable fleet driver skill. In this test the driver is required to back the vehicle into a marked stall representing the width of an alley. A test on ability to park parallel to curb is also given

Fig. 12 – Driving skill test No. 6. Important as an attitude-builder is this test involving use of the Brake-Reaction Detonator to demonstrate to the driver the distance he travels while reacting to a situation. He finds that it takes much farther for him to stop the vehicle than he thinks. Clipped on the front bumper this device, developed by the AAA, fires 22 blanks and capsules of paint. When measured on the pavement, the paint spots and the point where the car comes to rest indicate the driver's reaction-time distance and braking distance under actual driving conditions

lar hobby interests. Authorities have found that successful people in a certain occupation have as high as 75% interests in common. Thus, drivers who have an enviable driving record have a high degree of similar interests in things other than the job. Should an applicant's general interest be 75% the same as those of successful drivers, he should prove to be a good driver too.

9. *Attitude Test.* This test and the interview should reveal the attitude of the applicant toward the law, the "other fellow" and reckless driving. A driver may be mentally, physically and emotionally sound. He may know all the rules. He may be a master at the wheel, but, due to wrong attitude, get into difficulties regularly.

10. *Traffic and Driving Knowledge Tests.* This checks on knowledge of sound driving practices; signal and sign meanings; local, state and federal traffic and operations rules.

11. *State Driver's License Bureau Record.* To verify the applicant's own statements of violations and accidents, it is a good policy to check state files of drivers to whom chauffeur's licenses are issued.

12. *City Police and/or Traffic Bureau Record.* Local police or the Traffic Bureau usually maintain violation and accident files, which also should be checked.

13. *Fingerprinting Record.* A check of this record is favored by many employers. If fingerprints are taken, they should be handled by the local police, not the company. It should be explained to the prospective employee that it is for his protection as much as for the company's.

14. *Psychophysical Tests for Driver Limitations.* Practical special devices are available to help the employment manager discover physical or sensory limitations of an applicant. If the limitations are minor or capable of correction, the applicant may be sent to a doctor; or suggestions made on methods of compensating for the deficiencies. If too severe, then the applicant should not be employed as a driver. Typical tests are shown in the illustrations.

15. *Driving Skill Tests.* To determine an applicant's ability to handle a vehicle in close quarters, six carefully developed driving skill tests have been devised. These are being used more and more in effective driver selecting and training programs. Such tests should be given preferably on company property in a well-marked "testing area," or on a little-used city street (see illustrations). Detailed information on these basic, recommended tests, with scoring scales, are available from the American Automobile Association or from the Institute of Public Safety, the Pennsylvania State College.

16. *Driving Test in Traffic.* Many employment managers believe that the only way to get a true measure of an applicant's ability is to have him prove it in traffic. A road test is highly desirable

if given properly and *planned beforehand* so as to develop real facts about the applicant. The observer, using a check-list, rides with the applicant. The route should be known in advance so that the check-list will include all of the sound driving practices that should be followed when traversing it. These should include right and left turns, stop signs, traffic lights, a grade, curves, railroad crossing, and other maneuvers pertinent to the job. Each man's test results set the pattern for his individual retraining program.

"Driver Selecting and Training" is usually taken to mean that the acts of *selecting* and of *training* are two parts of the same procedure. This is not necessarily so because *training* may deal with drivers who are already "in service," whereas *selecting* usually implies choosing from applicants who are entirely new to the company, "training" occurring after "selection."

Training is having someone learn to perform an operation in a desired manner. Benefits expected from adequate training of drivers properly include reduction in operational costs, conservation of equipment, accident reduction, lowered insurance costs, maximum use of each unit of equipment and better relations between the driver, his employer, the customer and the public.

Training drivers is a *definite* procedure, though not necessarily complicated. As with any job to be taught, it is necessary to break it down into components to be certain that each necessary step is included.

Fortunately, basic physical operations in driving are few. To them must be added the "thinking" processes, and the proper driver "attitude" toward a given traffic or driving situation. Once the proper driver-acts and attitudes are completely understood and their development into habits begun, driving *skill* is accomplished through practice and repetition of these basic performances, *under controlled supervision,* until the acts become automatic. At this point, we say that a habit (or a series of habits) has been developed and that continued application of these habits leads to desired driving skill.

Training drivers today involves a number of problems, facts and conditions:

1. Many new drivers are in the younger age group and have had very little, if any, commercial driving experience. This can be fortunate, if we are permitted to train them so that only *good* driving habits and attitudes are learned.

2. Older drivers, who have not had competent driver training, may have picked up a number of bad driving habits. Fortunately, habits can be changed; but did you ever try to give up smoking?

3. Habits account for probably 90% of our actions. It is just as easy to learn a good habit as a bad one. It is imperative, therefore, that definite control be maintained over driving habits and attitudes being learned.

4. Safety is a *habit.* When the driver has learned the safe way to react to every driving situation, his reaction becomes automatic because it has become habit – and safety is assured. Safety is also synonymous with skill. When the best way is learned, it will also be the safe way.

5. Training (how to train) is a *learned* skill. People can be taught how to train, just as they can be taught how to drive a car, or how to operate a drill press. The person who is charged with the responsibility for training drivers first must understand "how to train." Then he must practice these training steps until skill in training is acquired. We often assume wrongfully that because a person can do a job well, he can also train others to do that job well. Responsibility is *not* discharged by the mere act of dumping the responsibility of training new drivers onto the shoulders of a skilled driver. If we expect to use a skilled operator as a trainer, he first must be taught how to train.

Regardless of the job to be taught, *principles of training* – four in number – are the same. Understanding and applying them to each training job will bring results far beyond expectation. They are: (1) Making advance preparations effectively, (2) Explaining and demonstrating the job to the learner, (3) Having the learner do the job himself, (4) Checking-up to assure desired habit formation. Importance of these principles warrants explanation as follows:

1. *Preparation:* (a) The instructor or trainer must prepare in advance so that he knows exactly what he desires the driver to learn. He breaks down the job through job analysis technique and determines how large a portion of it the learner can attempt at one time. Learning is like getting to the top of a ladder – you get there by a series of easy steps, not just by jumping from the ground to the top in one leap, (b) The learner must be prepared. He must be put at ease. He should be made to feel that he already knows something about the new job. Developing an attitude of confidence helps to shorten the time it takes the learner to achieve a particular step or learn to do a whole job well, (c) The location, equipment and materials needed must be prepared. Everything should be available and ready to operate or use at the required time.

2. *Explaining and Demonstrating the Job and Questioning the Understanding of the Worker as to how he is Going to Do it.* (a) "Explaining" isn't enough. Ordinarily we remember about 15% of what we hear, (b) "Showing" isn't enough. It is estimated that we retain about 60% of what we see, (c) "Demonstrating." Telling and showing – using the exact movements desired of hands and feet while telling the "why" of each movement – will result in more complete understanding of the job by the learner, (d) "Questioning." Up to this point all activity has been on the part of the trainer. Before permitting the learner to attempt the operation himself the instructor must be assured that the learner *understands and knows how*

to do the contemplated operation. The trainer, therefore, verifies understanding by questions beginning with What? Why? When? Where? How? Who? For example: WHAT are you going to do next? WHAT are you going to do after that? HOW are you going to do it? WHY are you going to do that?

Questions using these six key words demand that the learner explain his answer, rather than give a misleading YES or NO, often the only answer required to haphazard, unplanned questions. When the instructor has assured himself that the learner fully understands the contemplated operation then he is ready to react to the third training principle.

3. Having the Learner Attempt the Operation. Now we are interested in forming the correct operating *habits* of the learner. If possible, we want to assure that only *correct* actions are permitted. If the learner has only one choice for performing a given action, the habit will be developed around that one choice. If he is permitted to perform the act wrongly at first, he will thereafter have two choices: the *correct* and the *incorrect* way. In an emergency, the incorrect choice may govern his action. In the case of drivers who are found by "Driving Skill Tests" or observation to have already formed incorrect driving habits and attitudes, we have the problem of substituting new and acceptable driving ones. When the learner has once accomplished the operation by the correct method he has started to form a habit. Continued practice and repetition of this correct method is necessary before the habit can develop into a natural and somewhat automatic *skill.*

4. Check Up. The third step emphasized the formation of only correct habits. Continuation of the correct habits, making sure that incorrect actions and/or attitudes are not being formed, is the fourth principle. Frequency and intensity of check-up is a matter for the individual trainer or supervisor to determine. *The better trained the driver is, the less supervision he will require later.*

Correct training habits and attitudes must be learned and acquired by the instructor or trainer, before he can attempt to mold the thinking and learning of others.

The supervisor, during the course of his training as an instructor, should experience personally the entire battery of tests and exercises. He should attain a certain skill in them in order to interpret more intelligently the accumulated data on each applicant and hold the respect of his trainees and employed drivers.

Hundreds of fleet supervisors have learned to do the necessary modern job of driver selecting and training by attending one of the special one-week training courses now conducted annually at leading colleges and universities. They are under the sponsorship of the National Committee for Motor Vehicle Fleet Supervisor Training, organized in 1945, and supported by twelve leading national organizations: the American Automobile Association; American Mutual Alliance; American Trucking Association, Inc.; Automobile Manufacturers Association; Automotive Safety Foundation; Center for Safety Education, New York University; Institute of Public Safety, The Pennsylvania State College; National Conservation Bureau; National Highway Users Conference; and the National Safety Council.

This nationwide program has the merit of placing responsibility for fleet supervisor training with educational institutions, where responsibility rightfully belongs. Content and method of conducting the institutes have been developed over a period of eight years.

The lofty language and exaggerated promises of promoters are not effective with today's type of keen fleet management. "How much can we save?" "How can we improve our operations?" "How can we reduce our headaches in maintaining operations?" "How can we increase vehicle life and decrease maintenance cost?" These are the questions management wants answered. Here are conclusive answers!

Public liability insurance costs of The Willett Company, one of the large middle-west motor vehicle fleet operators, dropped two-thirds from 1941 to 1945, as a result of a driver selecting and training program. Before starting this program, the accident frequency for 100,000 miles of operation was running about 9.5. As a result of the program, this rate steadily dropped until it was about 3.5.

Another company reported that by utilizing this program, including pre-employment selection tests, it not only collected on lowered accident experience and costs but the program increased per hour deliveries to the point where such increased deliveries fully compensated for the driver selecting and training program.

A large milk company in Philadelphia reported a reduction of 69% in its accident rate the first year after introducing a well-balanced safety program.

The Atlantic Refining Company reports that in the Philadelphia area during the five year period from 1939 to 1943 it enjoyed a reduction of 52.5% in the frequency of all truck accidents, and that frequency of avoidable accidents also dropped 60%.

Fred Olson and Son, Chicago, report 52% reduction in their accident rate in 1940, the first year of a driver selecting and training program, and a substantial reduction each year since.

In 1943, an accident prevention division of the City of Boston Cab Association was organized. The accident frequency rate during 1942-43 per 100,000 miles of operation was 10.1. Since inauguration of a training program, the frequency rate has decreased to 7.28 per 100,000 miles. This decrease resulted in a decreased premium from $394.00 per cab to $381.00, or a saving of $13.00 per cab. Members of the association operate 1200 vehicles. At

concluded on page 69

RUBBER SUSPENSIONS

THAT rubber can be compounded, designed, and engineered into suspensions for a wide range of equipment including automobiles, buses, trucks, trailers, airplanes, railway cars, and tracklaying vehicles is the belief of engineers in the rubber industry. Considerable experimentation has been conducted by engineers in the rubber industry in collaboration with automotive suspension designers.

Apparently the stage is set for some real constructive work with chances of accomplishment as automotive engineers are receptive to rubber as a suspension medium. Recent remarkable accomplishments have increased our technical knowledge and adaptability of various rubbers (both natural and synthetic), and make any efforts along this line seem much more plausible and likely to produce effective results.

Automotive suspensions are an engineering specialty in themselves. One has only to view the great variety of suspensions designed and engineered into all types of vehicles to become impressed with this. Because of its wide scope and the considerable engineering involved in its three functional elements – elastic element, shock absorber, and structural – only the elastic element of the suspension will be discussed here.

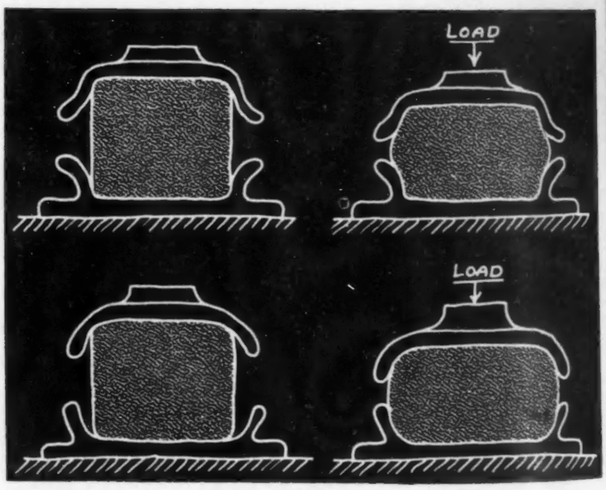
Let us consider "spring rubber" as we do "spring steel," using elastic deformation and recovery properties of rubber properly designed and engineered to function as the elastic element and provide such functional characteristics as load-deflection, periodicity, and rate.

Rubber as the elastic element offers a wide variety of basic functional forms which can be classified as follows:

- A. Straight Loading
  - 1. Compression Distortion
    - a. Block
    - b. Column
    - c. Special Shapes
  - 2. Shear Distortion
    - a. Plate sandwich
    - b. Coaxial bushing sandwich
  - 3. Tension Distortion
- B. Torsional Loading
  - 1. Compression distortion
    - a. Rotating cylindrical
    - b. Rotating disc
  - 2. Shear Distortion
    - a. Rotating cylindrical
      - 1. Torsilastic
      - 2. Lord
      - 3. Robertson
    - b. Rotating-plate sandwich
    - c. Rotating conical.

The sketches which follow will illustrate these various types and convey the basic principle of each form of elastic element. By coupling his imagination and inventiveness, the suspension designer should envision many size and shape variations to fit a successful suspension.

Here is shown a simple block in direct compression:



The forms of the two different geometric mountings indicate the possibility of influencing load deflection characteristics according to the way the

* Paper "Rubber Springs for Automotive Equipment," by J. E. Hale, The Firestone Tire & Rubber Co., was presented at SAE Cleveland Section, May 13, 1946.

RIGHTENED KNOW-HOW"

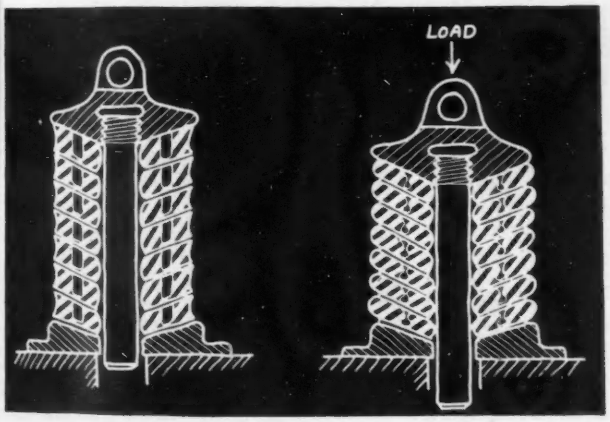
FROM A PAPER BY **J. E. HALE***

The Firestone Tire & Rubber Co

mountings are designed. Since this is an example of employing rubber elasticity in direct compression, the relationship between the horizontal cross-section area and vertical height should be such that the block is broader than it is high – in the interests of general stability.

This form of elastic element is limited to very heavy loads where limited cushioning is desired. It is particularly adaptable to heavy duty applications. The block can be deflected vertically 20 to 25%.

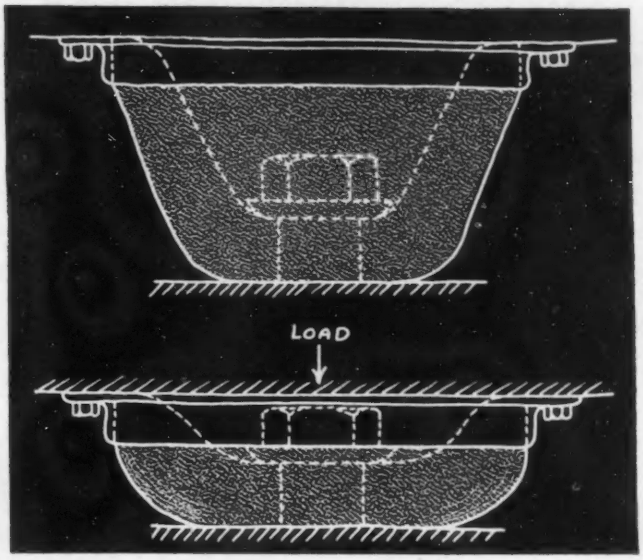
Following is another form of direct compression spring in which a greater deflection by compression can be utilized:



It can be described as a stack of compression discs in column form. When separated into elements, the unit is a metal disc with two rubber rings cured to one face of the ring and arranged to nest and group one above the other.

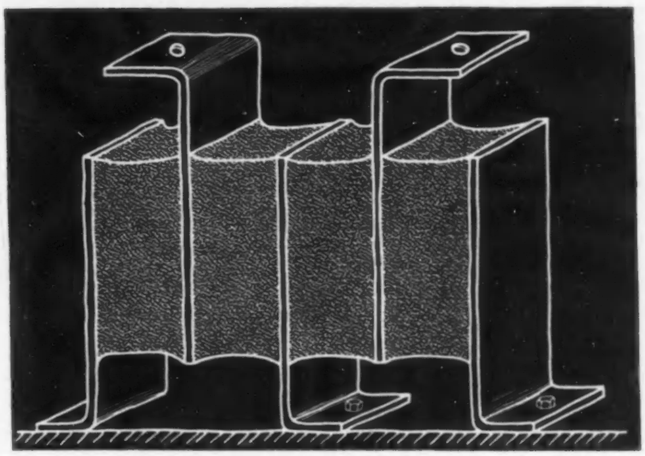
For example, if one element is 1 in. thick, it can be deflected a maximum of ¼ in. Total amount of deflection desired can be achieved simply by increasing the number of units in the assembly. Metal guides can be provided for structural purposes.

Still another form of distortion in compression is illustrated to show the extent to which the designer's ingenuity can create any one of a multitude of special shapes:



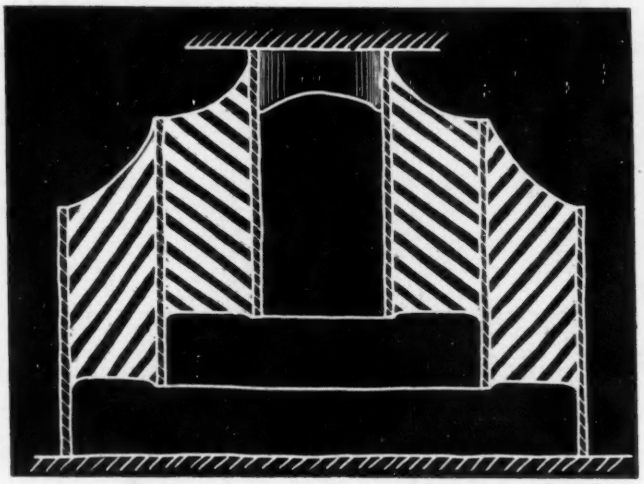
In this particular case it is the shape of a bowl with very thick walls. This device was actually made and tried on a trailer. It was fairly satisfactory and probably could have been made to work had the tests been vigorously pursued.

Passing from compression to shear distortion we encounter one of the innumerable possible forms that might be called a plate sandwich in shear distortion:



The elastic element in this case can be designed and cured effectively in large units.

Next is a sandwich form which would be described geometrically as a coaxial bushing:

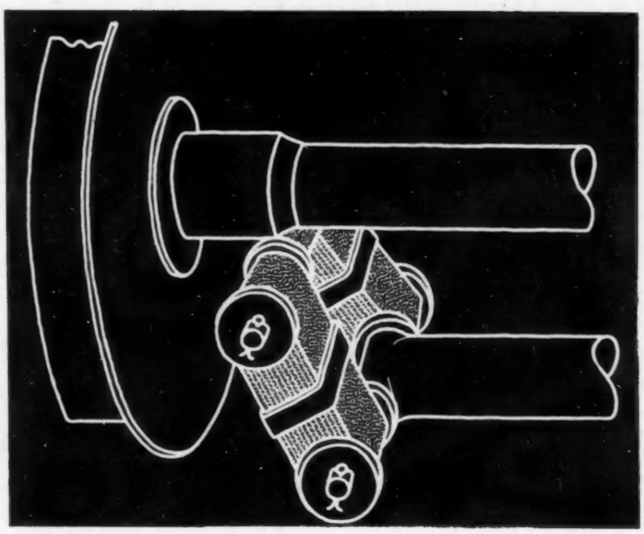


Here again the designer can have a wide range of dimensional and deflection possibilities according to the way he designs the elastic cushioning element.

It would be desirable in the case of coaxial bushings to make every reasonable attempt to recognize and provide for arranging of relationships of the bonded surfaces.

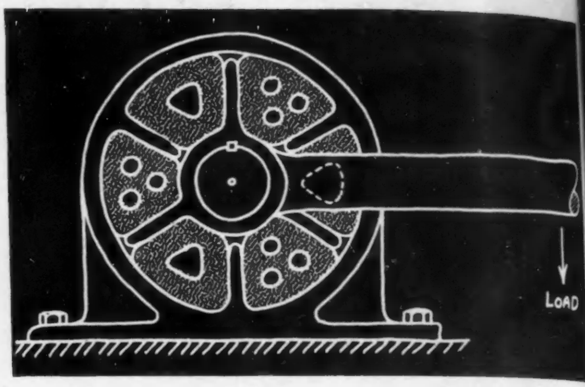
This would require that the different diameter shells be graduated in length to equalize the bonded area and also that the wall thickness of the rubber be properly designed to give dimensional deflection characteristics commensurate with the uniformity of the shells.

In direct tension rubber can also be used as the elastic element. How this might be done is illustrated in this next sketch:



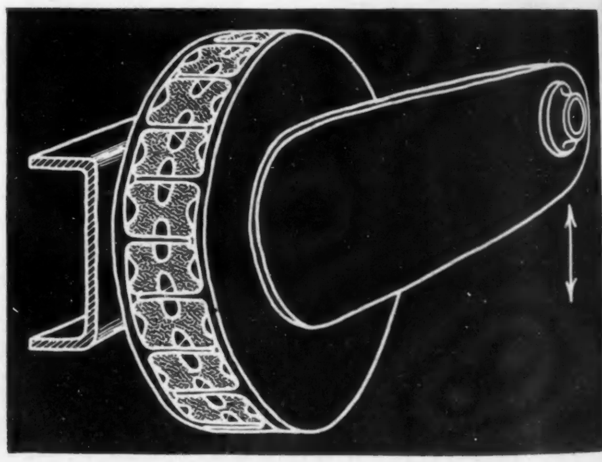
Most of us are familiar with shock cords used in light planes as the elastic elements. Obviously there are many possible varieties of the use of rubber in tension.

The first of a series in which the elastic element is loaded torsionally is shown next:



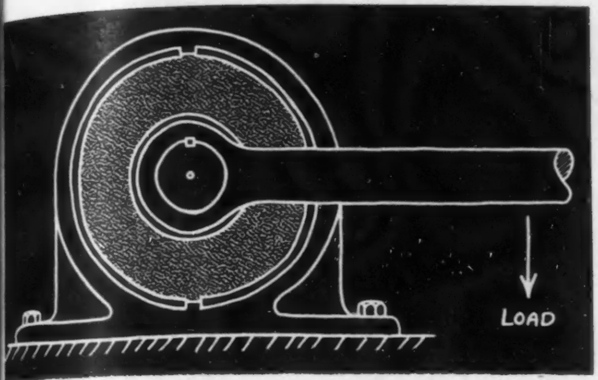
In this case the torsion loading resorts to compression of the elastic elements which are provided with suitable cavities to permit distortion in compression. Additional rubber under compression is also provided to take care of rebound. In this particular form the diameter of the torsional unit would be relatively small with a rather lengthy axial dimension.

Torsional compression distortion can also assume the following form:



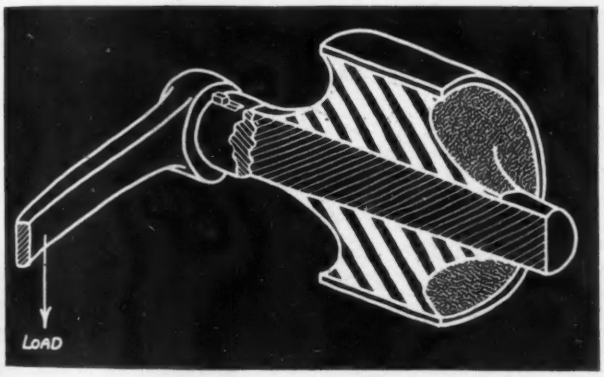
In this case it might be described as an interlocking plate with ribs embracing elastic members in such a way that torsional cushioning is provided. The geometric relationship of this is more in a disc form than an elongated cylinder.

Torsion elastic elements can be set up in shear in several forms. The first of these is a cylinder bonded to an inner and outer sleeve combination as shown here:



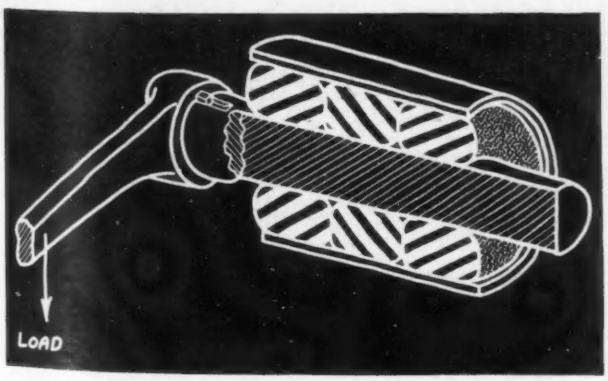
The outer sleeve is split for manufacturing convenience and its holder is compressed to maintain pressure in its holder bracket and keyed against rotation.

The French and Germans also made great strides in the field of rubber suspensions. Back in the late 1920's the French Garson car had a chassis with independent rear suspension. It incorporated four stacks of rubber discs.



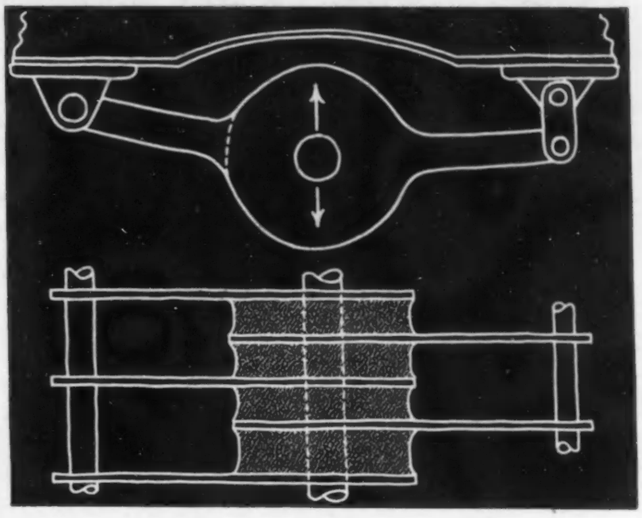
Here the adhesion on shaft is very much elongated to get equal bonded areas.

Illustrated next is a possible suspension element making use of the so-called Robertson bushing type:



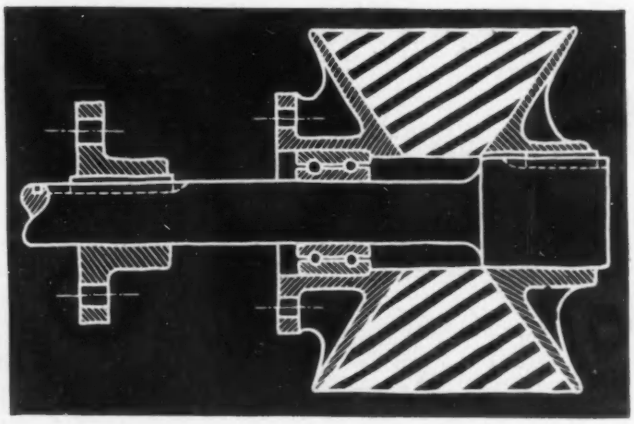
These rubber elastic elements are in the form of rings on the central shaft. The entire unit is pressed into the outer shell, distorting the rubber which depends on the friction of the outer shell for its grip. This form was used not as springs but as bushings in American Army tank tracks. It has also been used as small springs for office chairs.

Shear distortion can be developed in the following plate form:



The rotating plate shown for handling torsional loading is just one possible configuration of this form.

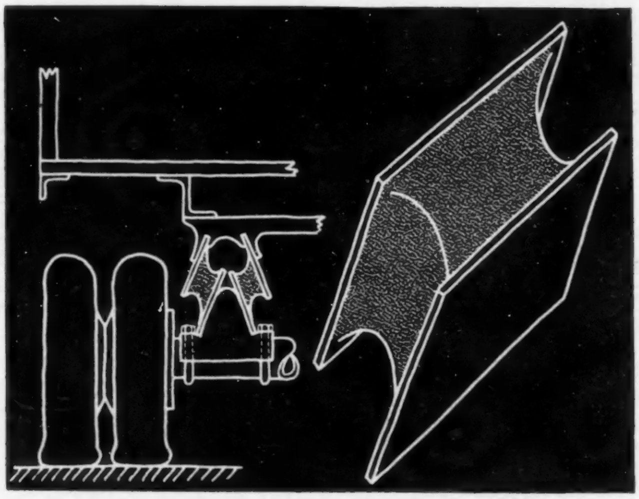
Depicted by the following diagram is a promising type for rotating shear distortion that could be called a conical sandwich:



In this principle – contributed by Colvin Macbeth, a well-known English rubber engineer – the rubber is bonded to the two conical surfaces; provisions are made for a mounting to develop torsional shear, functioning action of the elastic element operating as a spring. The conical shape

makes it possible to employ the rubber spring in torsion to the same degree of angularity from the inner to the outer diameter, thereby working the rubber uniformly throughout the element.

This plate sandwich next illustrated carries a diagonal loading combining both distortion and shear:



The form is a bit difficult to draw in perspective because of the peculiar offset relationships of the two steel plates to which the rubber is bonded. It is being worked on as a cushion element in draft gears of railroad tracks. The sketch suggests treatment of this form as an automotive vehicle spring. This element also has great possibilities by virtue of the wide variety of dimensional characteristics and elastic qualities of rubber compounds that could be employed.

Functional Properties Within Reach

What are the chances of designing rubber as the suspension elastic element to give proper functional and durability properties at reasonable cost? It seems fair to predict that this can definitely be worked out by taking advantage of the much enlarged technical "know-how" developed through physical and chemical research in the last few years. Frequency, rate, load-deflection, and damping are all characteristics which can be obtained through compounding and design details with the great range of rubber's functional properties.

The rubber compounder can design his stocks to a broad range of modulus values in compression, shear, or tension. By compounding he can control rubber efficiency and tailor stock stiffness to the suspension as a whole.

If rubber can function effectively in eliminating vibration and noise in shackles and other joints, it seems reasonable that it can be expanded to act effectively as the suspension elastic element, provided it is properly designed.

Durability should be no problem to the designer and compounder with laboratory and technical background. The compounder can provide for resistance to solvents, greases, oils, and aging. Permanent set and related phases of creep and stress relaxation may be questioned. Provisions for taking up permanent set may be necessary in some rubber suspension forms, but this should not be insurmountable.

Bonding of rubber to metal is an important phase. Bonding required in most of the forms discussed has been so effective that premature failure can be eliminated as cause for concern.

The functional property least understood at the present state of knowledge is the degree of damping obtainable from the rubber elastic element. This needs further exploring but offers an effective compromise in the hysteresis that can be built into rubber itself.

Permanent set or creep is a property for which allowance will have to be made in using rubber as a suspension elastic element. This problem can be overcome despite skepticism of some engineers. Variation of rubber elastic properties with atmospheric temperatures is another area where the rubber compounder's skill can develop a suitable formula.

Make for Quiet Ride

One of the most common complaints about existing suspensions is the transmission of road noises up through the tires to the body compartment. With the rubber elastic element and rubber-bushed shackles, pins, and other connections, road noises could effectively be eliminated.

Another important angle is the relationship between the suspension elastic element and the functioning of the tire and seat cushions. Periodicity of tires is high – 500 to 600 cpm. Working out such periodicity to avoid a buildup from tires and seat cushions appears possible.

Compared to spring steel, rubber in some ways is a more adaptable medium as a basis for design. For example, spring steel is limited to about 2% elastic deformation. Furthermore, steel springs are quite limited in the physical shapes that may be used as springs and are limited to simple bending and torsion members.

Spring rubber on the other hand has an elastic deformation with recovery up to 600 or 800%. It can be distorted enormously in many ways or directions, offering the suspension designer a great assortment of linkages and load compoundings as shown.

Interesting comparisons of spring rubber with other spring forms as regards stored energy is shown in Table I.[a]

Much work has already been done with rubber

[a] From paper entitled "Flexible or Spring Medium of Suspensions" by Robert Schilling in SAE Journal (Transactions), Vol. 54, July, 1946, p. 367.

suspensions – especially in Europe. Prominent in British circles is the Macbeth design that consists of a torsional spring employing the rotating conical cones with the rubber bonded and functioning in shear. Fig. 1 shows the rubber spring for the right front wheel.

Table 1 – Comparison of Stored Energy in Various Spring Forms

Spring Form	In.-lb of Energy per lb of Spring
Leaf Springs	300 – 450
Helical, Round-Wire, Coil Springs	700 – 1100
Torsion Bar Springs	1000 – 1500
Volute Springs	500 – 1000
Rubber Spring in Shear	2000 – 4000

It is one of several forms in which torsion elastic elements can be set up in shear. In this case the outer sleeve is split for manufacturing convenience and its holder is compressed to maintain pressure in its holder bracket and keyed against rotation.

An American design of note is the Goodrich torsilastic spring, shown in Fig. 2, that has already gone into production on Twin Coach buses. It was used in large numbers during the war for LVT bogies.

Another type developed in this country is the Firestone air spring. Its three elements, Fig. 3, are the bellows, the auxiliary reservoir, and connecting tube. The bellows are made of cord fabric with rubber coating inside and out. An experimental air-spring installation in the rear of a car is shown in Fig. 4. It also has been applied experimentally to airplane landing gear struts.

These and other advanced possibilities indicate the persistence of rubber engineering. A growing knowledge in rubber chemistry and physics brightens the suspension designer's outlook. The day of improved suspensions using rubber is rapidly approaching.

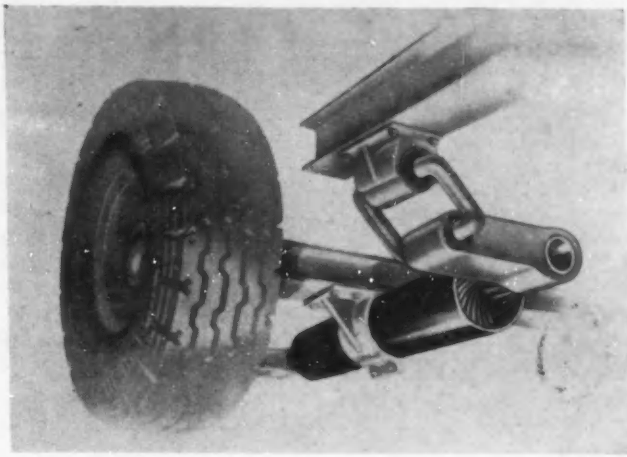


Fig. 2 – The Goodrich-designed torsilastic suspension is being installed in Twin Coach buses

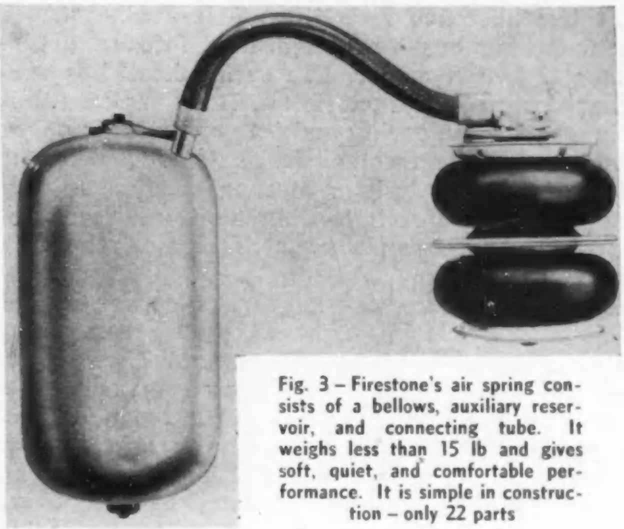


Fig. 3 – Firestone's air spring consists of a bellows, auxiliary reservoir, and connecting tube. It weighs less than 15 lb and gives soft, quiet, and comfortable performance. It is simple in construction – only 22 parts

Fig. 1 – The Macbeth (British) rubber suspension consists of rotating conical cones with rubber bonded and functioning in shear

Fig. 4 – This is an experimental air-spring installation in the rear of a car

RUBBER SUSPENSIONS

AN independent 4-wheel suspension fully exploiting inherent possibilities of the rubber suspension spring has been engineered into an experimental passenger car. The spring itself has some very desirable characteristics. But complete familiarity with the spring and its properties is only a first and easily accomplished step in working out a satisfactory design. Mechanical ingenuity in applying the spring to obtain desired results is by far the most important factor in the final product.

At the inception of this program, it was decided to break with tradition where careful examination indicated that an accepted tradition either did not apply to this new type of spring, or as sometimes happens, where we felt that the tradition was not supported by analysis. However, every effort was made to avoid the "air brush" school and to retain where possible those principles and features which have found public acceptance. While the design was intended for a single experimental car, we approached the problem as though sales and production organizations had to be satisfied.

The light-weight passenger car with normal accommodations for 5 passengers presents an unusually large number of problems either directly or indirectly related to suspension. The rubber torsion spring makes possible a new approach to many of those problems. This design is for 104 in. wheelbase and an empty dry weight of 2400 or 2500 lb curb weight. Hand work on body and sheet metal, with considerable use of solder to save time in filling the metal surface, added 150 lb to this weight on the experimental car.

We have set for our objective a car which will provide normal leg room and seating comfort; handle easily and nimbly in traffic; be comfortable and safe; and *feel* safe[1] whether in city traffic or on open roads at high speed; have an inherently low degree of harshness and low noise level, and require a minimum of maintenance together with long life and low operating cost. We believe that with all these objectives, the car must also have smart and attractive lines.

Suspension is one of the most important factors in achieving such a design, and suspension in turn must influence much of the chassis design. Change in car height with changes in load, brake dive, and roll are three primary suspension problems which increase as the car is reduced in size. Most light cars to date have met this problem by using relatively stiffer springs, in terms of nominal deflection or natural frequency, than would be acceptable on a larger car, and giving the light car a distinctive feel such that a blindfolded passenger could guess quite well the size of the car in which he rode.

For example, it was thought that 8 in. nominal deflection with driver only was desirable. Cars in the luxury class with good ride often have considerably softer springing—up to 11 in. nominal deflection. Springs with even 8 in. nominal deflection, used on a 2400-lb car, would sag roughly 3 in. at the back in going from an empty car to 5-passenger load, and brake dive and possibly roll would be serious unless some design features were worked out to minimize these effects.

It is quite possible to obtain a good ride with fairly stiff springs if the car and the springs are well balanced, the car weight well distributed with a reasonably high radius of gyration in pitch, or K^2/ab ratio,[2] and if static friction is reduced and harshness and noise level lowered. However, it is wishful thinking to expect a soft smooth ride without paying some of the price in soft spring rates. The rubber industry in particular has been the

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[1] See SAE Journal (Transactions), Vol. 48, No. 3, 1941, pp. 81-93: "Car Control Factors and their Measurement" by K. A. Stonex. Also see paper entitled "Fundamentals of Suspensions" by H. E. Churchill, P. G. Hykes, and M. Z. Delp presented at the SAE Annual Meeting, Jan. 9, 1946 and digested in SAE Journal, Vol. 54, No. 7, 1946, pp. 74 and 75.

[2] See SAE Journal, Vol. 34, No. 3, 1934, pp. 73-81: "Independent Wheel Suspension – Its Whys and Wherefores" by M. Olley.

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* Paper "An Independent Four-Wheel Suspension Using Rubber Torsion Springs", by Messrs. Krotz, Austin and Lindblom, B. F. Goodrich Co., was presented at the SAE Summer Meeting, June 3, 1946.

EXCERPTS FROM PAPER BY **A. S. KROTZ, R. C. AUSTIN, and L. C. LINDBLOM***

...ESIGN EMERGES ...ORSION SPRING

victim of this misapprehension since many people believe that a pinch of rubber at the right places will in itself make a good ride regardless of high nominal deflection.

Anything like a 3-in. change in spring level with normal load changes is particularly objectionable in a small car with short wheelbase; it represents a serious change in stability, a considerable handicap in appearance if a full sized body must be used, and various mehanical disadvantages such as high universal joint angularity.

Because of these considerations, it was decided to incorporate a constant-level device in the design to hold the chassis at designed level regardless of load changes. This feature was used on both front and rear suspensions although there is less need of it in front with conventional seating arrangements. Rubber torsion springs, or any type of torsion springs, lend themselves to constant level mechanism. A simple and relatively clean system was worked out as described later.

Torsilastic Spring

The Torsilastic spring used is fairly well known in the industry by now. It is composed of a central shaft or tube and an outer cylindrical shell with a cylinder or rubber between, and bonded on its O.D. to the outer shell and on its I.D. to the shaft. The inner and outer metals of the spring may either or both be steel or aluminum or in some cases cast steel. Such a spring performs its own locating function and needs no bearings, as it resists tilting, axial and radial deflection about its normal axis.

It needs no lubrication and cannot rattle or squeak. It eliminates the dry friction effect present in leaf springs and in some pivot bearings used with coil springs. The outer shell is usually split into two 180-deg segments as a means of manufacture and to permit shrinkage during cooling. One member of such a spring, either the shaft or the shell, is held stationary and the other rotated by means of a torque arm, which in this case is the wheel support arm.

When the spring is deflected rotationally, the rubber cylinder is placed in shear. The objectionable end effect experienced on flat shear springs is not present since the circular form of the tube of rubber may be thought of as a continuous shear sandwich without ends. For this reason, the spring can be stressed much higher than flat shear sandwiches or most other types of rubber springs. We operate actual installations at static stresses up to 200 psi shear on the rubber I.D., although for most automotive applications, the static stress will not be this high. Maximum stresses may run well over 200 psi and we stress springs in the laboratory as high as 600 psi and more.

Stress range is very important in rubber spring design. The springs on this experimental car have static loaded stress of 146 psi in front and 151 psi in the rear with four-passenger designed load. Bump stress is 226 psi in front and 250 psi in the rear. These stresses were determined by mechanical and space considerations as well as by predicted life based on estimated average passenger load.

We believe that the slight flexibility of this spring in resisting forces other than rotational is an important advantage in cushioning impacts and reducing noise level and harshness. While new uses are being developed for this type of spring, there is sufficient background in many fields, such as automotive suspension, to take it out of the experimental category and make it a definite production possibility. Actual production of these springs to date has been between four and five million dollars in volume and present production is rapidly overtaking the high wartime volume.

The general character of the chassis is shown in plan and side elevation in Figs. 1 and 2. The front and rear suspensions are shown in more detail in Figs. 3 and 4. The design is unconventional, particularly in front. It is intended for use either with or without a frame although a frame was used

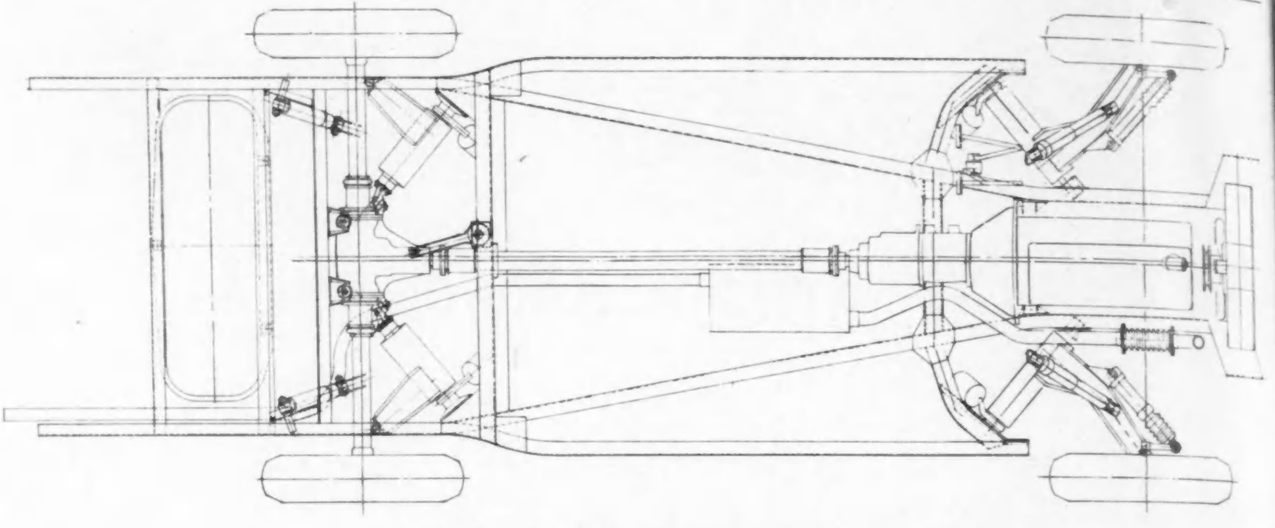


Fig. 1 – Plan view of the independent 4-wheel suspension

on the experimental car. Modifications in spring rate and some range of vehicle weights can be accommodated by springs which are identical except for the modulus of the rubber used.

The front suspension is a single wheel support arm mounted on the outer member of the cylindrical rubber torsion spring. The spring axis is mounted diagonally close to the dash which is a focal point of combined strength and rigidity of body and frame (if a frame is used).

Camber

Change in camber can be assumed to be the same as for a single swinging arm, viewed from the front and swinging from the point of intersection of the torsion spring axis with the vertical transverse plane containing the wheel spindles. The change is shown graphically in Fig. 5 and is nearly a straight line function with a value of 1 deg 50 min per 1-in. stroke. Gyroscopic forces resulting at 60 mph and with the wheel rising and falling a total of 1 in. in 0.075 sec (which would be roughly the wheel hop frequency at that speed) would develop approximately 620 lb-in turning moment at the king pin. This magnitude of camber change assumes that the plane of symmetry of the vehicle will remain unchanged.

For roll the change in camber is 0 deg 4 min for every deg the car rolls, and in the same direction as the car rolls. Put into different words, the proposed geometry is about midway between the camber change obtained with conventional axle type suspensions and that obtained with most American independent front wheel suspensions.

From the point of view of handling, a desirable understeering effect may be obtained by loss of cornering power when the wheel is cambered in the direction in which the car rolls.[3] The generally accepted geometry for independent front wheels is to take as little camber change as possible for small wheel strokes. This means that the wheels remain parallel to the plane of symmetry of the car for small wheel strokes. When the car rolls, the wheel therefore rolls to nearly the same degree.

The obvious fault with this geometry is that the understeering effect is obtained by loss of cornering power of the tire so that to negotiate a given

[3] See SAE Journal, Vol. 36, No. 2, 1935, pp. 41-49: "Properties of Tires Affecting Riding, Steering, and Handling" by R. D. Evans. See also SAE Journal (Transactions), Vol. 45, No. 2, 1939, pp. 344-350: "Tire Behavior in Steering" by A. W. Bull.

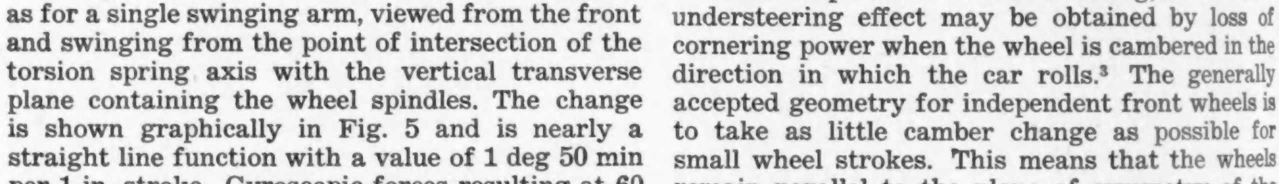


Fig. 2 – Independent 4-wheel suspension installed in the Goodrich experimental car shown in elevation

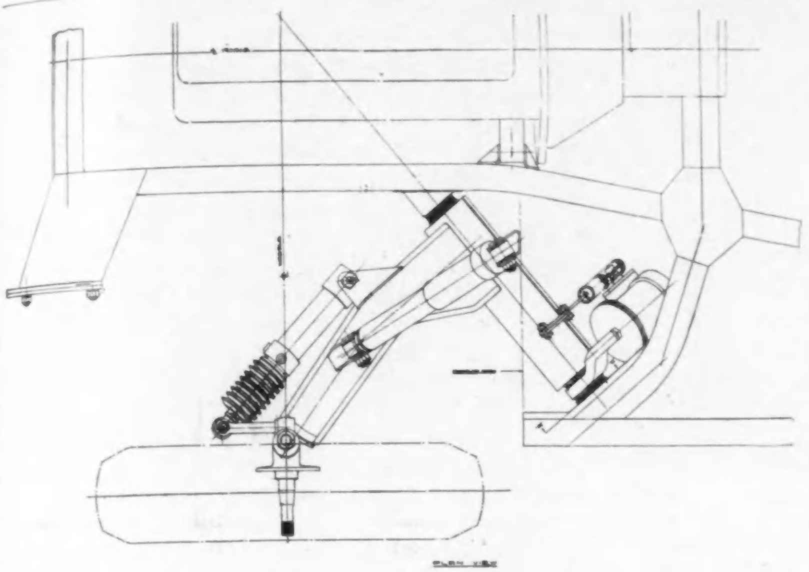


Fig. 3 – Front independent suspension using rubber torsion springs

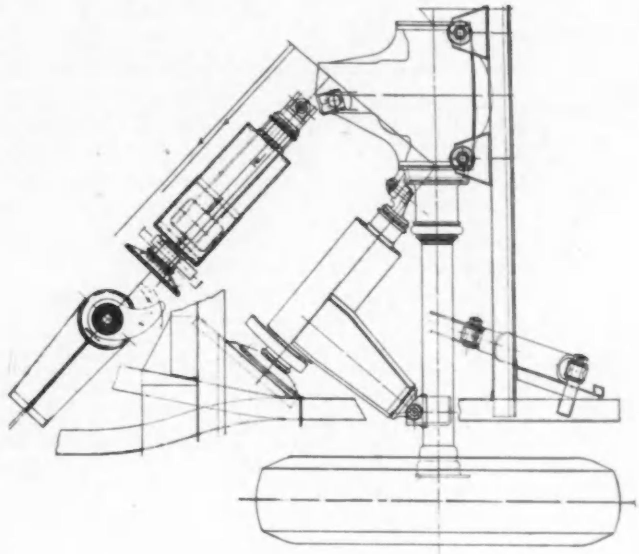


Fig. 4 – Plan view of the rear suspension

turn, the wheel must be turned further, giving the tire a greater slip angle than would be necessary if the tire remained more nearly perpendicular to the road. This increases tire wear and may be an appreciable factor in over-all wear of front tires since most wear occurs while braking or while cornering. Another means of obtaining understeering is of course by intentional steering error to be discussed later.

The change in caster is also nearly a straight line function with value of 2 deg 10 min per in. wheel stroke as shown in Fig. 6. During pitching, this change is decreased since the longitudinal axis of the car tilts and neutralizes some of the change. It is thought that change of caster during wheel stroke is unimportant with inherently neutral steering, except as it is an index to the brake path.

Steering Error

Steering error is shown graphically in Fig. 7 and turns the wheel out slightly as it rises, and in slightly as it falls for the first 2 in. of stroke (the rubber torsion spring is mounted 2 in. below the plane of wheel spindles). This is an added understeering factor since both wheels, on cornering, steer out of the turn. This effect is obtained without losing the cornering power of the tire and therefore with less tire wear than would occur with the same understeering effect obtained by camber change.

Brake Path

The brake path, shown graphically in Fig. 8, can be visualized as the result of swinging the locked wheel in the vertical longitudinal plane of wheel track about a center at the point where the torsion spring axis intersects that plane. The tangent to the curve is the instantaneous path of the point of contact of the locked tire on the road and is such as to give a lifting component during braking which will approximately balance the load transfer to the front.

Track change is shown graphically in Fig. 9. Most American designers have chosen to give the front wheels zero track change. Two reasons are usually given for this: to reduce tire wear and to avoid steering disturbance. We believe that the first reason, tire wear, is not valid unless subjected to some qualifications.

Those wheel movements due to pitching or bouncing of the vehicle on the springs are at frequencies well below 100 per min and therefore in one cycle of wheel stroke, the car, at even 30 mph, travels more than 30 ft. A 2-in. total stroke and the relatively large corresponding track change of 0.75 in. shown in Fig. 9 is therefore taken in 30 ft or more of travel and it is difficult to be alarmed

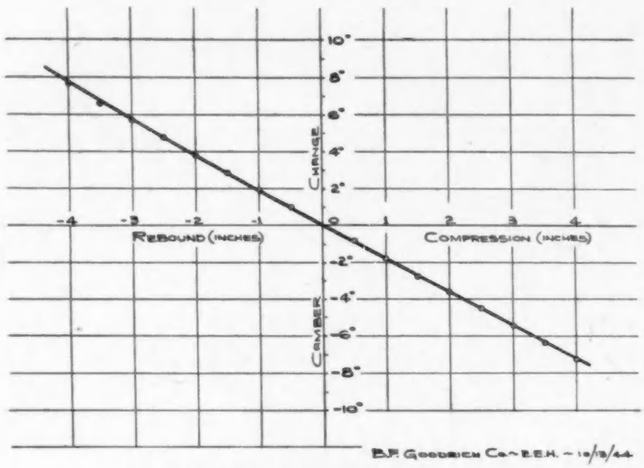


Fig. 5 – Camber change of the front wheel is nearly a straight line function

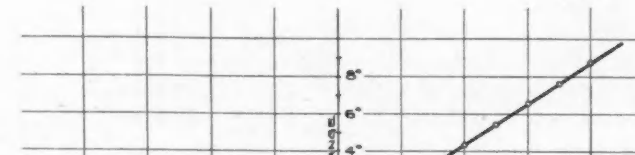


Fig. 6 – Front-wheel change in caster decreases during pitching

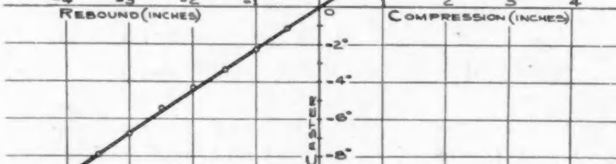


Fig. 7 – Front-wheel steering-angle change

about tire scuffing. We believe this contention is borne out by the many "swing axle" suspensions operating in Europe on all sizes of cars with no apparent disadvantage as to tire wear. A much more important source of tire wear was discussed above relating to camber.

The second reason given for the efforts made to obtain zero track change is to avoid or reduce front wheel disturbance. Even with zero caster, any side thrust on the tire, while the tire is rolling, develops moment about the king pin. Therefore, track change does provide a disturbing factor. In this design, we believe that we can avoid wheel disturbance regardless of having considerable track change because of the type of steering used.

If a line is drawn normal to the track change path (front elevation of car) in Fig. 9, it will intersect the plane of symmetry of the car in the instantaneous roll center. The roll center for the front suspension is 9.9 in. above the ground in designed position.

Wheel Hop

The wheel hop frequencies for this car will be somewhat faster than usual, due to low unsprung weight and small rolling radius (12.59 in.). At an upper limit of 90 mph the wheel turns over 1200 rpm. The unsprung mass of the front wheels will have a natural and more or less undamped frequency in a direction parallel to the torsion spring axis. This movement is made up of two components, the axial displacement and the tilt of spring on its fixed axis. The elastic rate of this deflection is approximately 5600 lb per in. at the center of the wheel and gives the unsprung mass a natural frequency of approximately 1750 cycles per min, which we believe is high enough to avoid any resonance. The torsional rigidity of the front end of the chassis is inherently very great with this design and ceases to be a factor.

Steering

Steering linkage and geometry required particular care in this car. We have invited some steering disturbance by track change and camber change with wheel stroke. A further problem is introduced by the diagonal mounting of the front springs. The Torsilastic spring functions best when given some freedom for slight movements other than rotational.

The steering linkage must permit this movement without steering error. For these several reasons, it was decided to use hydraulic steering, with the wheel elements located on the wheel support arm so that any elastic movement of the arm causes no steering error and the hydraulic system inherently resists and damps any harmonic impulses from the wheel. Although a mechanical steering system is quite possible with rubber torsion springs, even as laid out for this car, the advantages of hydraulic steering should not be ignored. Every car ever placed on the road has an inherent tendency to wheel disturbance under some circum-

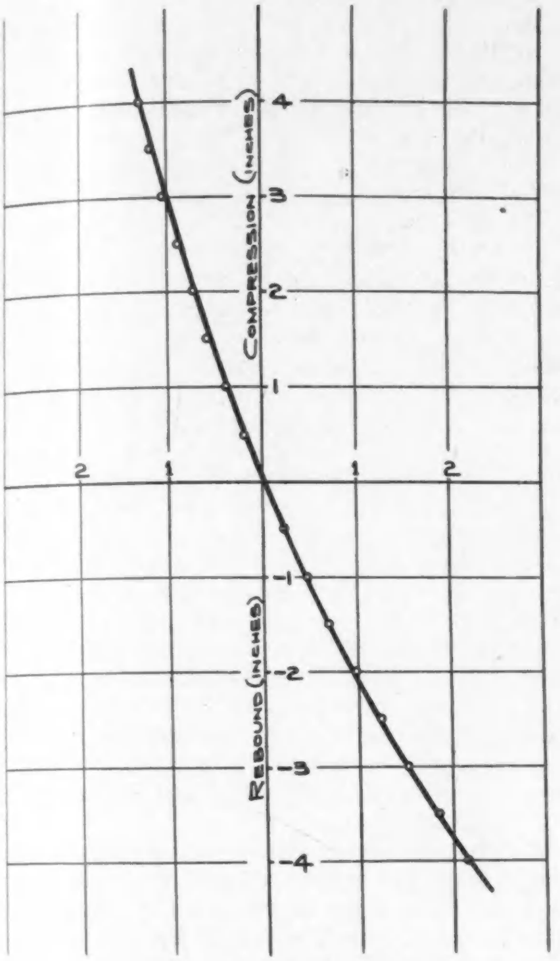


Fig. 8 – Front-wheel brake path

stances. A contributing factor is, of course, the rotational acceleration of the wheel every time the tire deflects over an irregularity in the road.

There are two questions which must be answered before hydraulic steering can be considered seriously. First, is it reliable? Many of us remember the charges years ago that hydraulic brakes would never be safe. Such failures as occur today in hydraulic brakes can be attributed to the understandable effort to balance cost against required brake life. Hydraulic steering parts can be made to give any required length of life, and the cost involved is not serious when compared with the cost of mechanical steering.

The second question is the ability of the hydraulic system to maintain wheel alignment. As illustrated schematically in Fig. 10, the proposed system is comprised of two hydraulic circuits, one of which is virtually a hydraulic tie rod between the two wheels. It is a balanced circuit which is sealed except for such leakage as transfers from a pressure chamber on one side of the piston to a pressure chamber on the other side of that piston. The whole system, including what we call the balanced circuit and the pump circuit are kept under a minimum positive pressure by a spring loaded reservoir.

Similar systems are working in thousands of control circuits without leaking a drop in months. Such leakage as occurs in the pump circuit has no effect on the wheel alignment. Such leakage as occurs in the balanced circuit, together with any misalignment due to accident, can be corrected by mechanical adjustment provided or by a fluid displacing screw in the balanced circuit.

Rear Suspension

The rear suspension is of the independent swinging axle type with one universal joint per wheel. The differential is carried on the frame in rubber mountings and the usual universal joints on the propeller shaft are replaced by simple rubber sleeves. One of the major disadvantages of this type axle has been the change in wheel camber with changing load. Even on large cars such as the "Grosser Mercedes," the camber change from no load to full load is sufficient to introduce a disagreeable rear axle steering effect. In this design we have the constant level feature which holds the chassis at designed height regardless of load change. Therefore the major objection to the swing axle disappears and leaves some very desirable features.

The Torsilastic spring used for suspending each swinging axle is mounted diagonally on an axis passing through the universal joint center. These diagonal axes, diverging toward the front of the car, also slope downward slightly at their outer ends.

The roll center of the rear suspension is 15.2 in. above the ground and that of the front suspension is 9.9 in. above the ground. A line connecting these centers may be assumed to be the roll axis of the vehicle. The rolling moment of any increment of mass, may be assumed to be the mass times its dis-

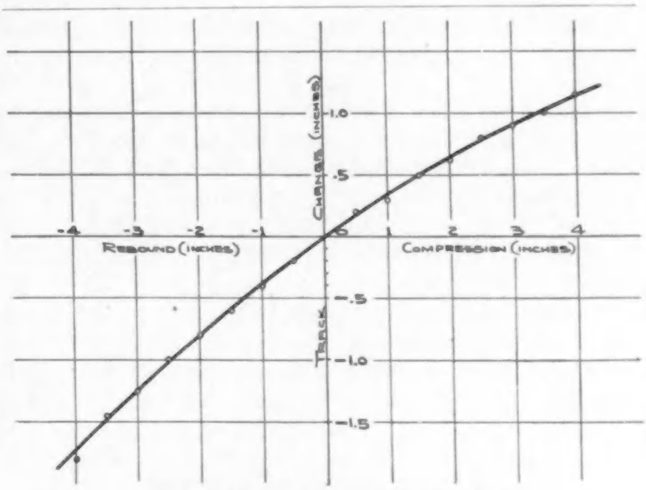


Fig. 9 – Track change of front wheel. Zero track change for the front wheel is usually chosen by American designers to reduce tire wear and avoid steering disturbance

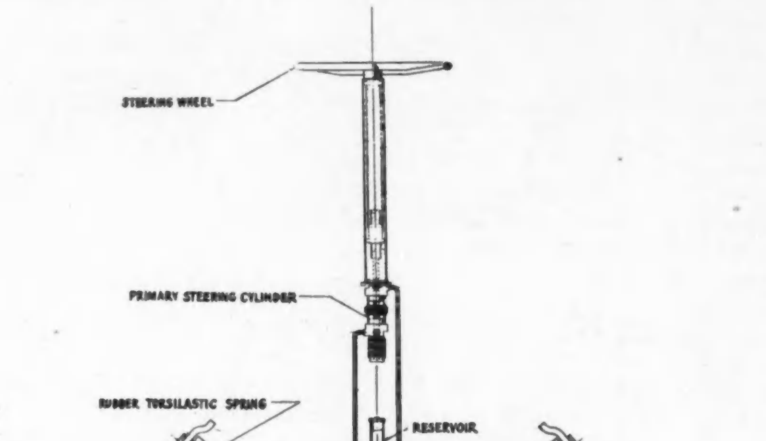


Fig. 10 – The hydraulic steering system has two hydraulic circuits

placement above or below the roll axis. We have attempted to locate the roll axis at a height sufficient to prevent excessive roll without the use of roll stabilizers. The objection to roll stabilizers is twofold. They are an added complication and for any car having such a control, the customary figures for spring rate and nominal deflection apply only to pitching and not to independent motion of one wheel.

Constant-Level Mechanism

The constant-level mechanism has been applied to all four wheels. It is illustrated schematically in Fig. 11. The change in loading is much greater on the rear wheels since conventional seating is used and also the front geometry has less steering error and camber change than the rear. However, the added complication of providing constant level in both front and rear was not great and it was decided to incorporate this feature and study the results.

The constant-level system is hydraulic, comprising a single source of hydraulic pressure and a small working cylinder at each of the four suspension springs which rotates the spring shaft to maintain the designed height of the chassis. A pressure-sensitive switch keeps the operating circuit under 500 to 550 psi. At each spring a lever, which moves with the wheel support arm, controls the position of a hydraulically damped slide valve which ports the working cylinder either to the high pressure system or to a low pressure return system. Small coil springs are interposed between the lever and the slide valve so that for any normal wheel movement the dash pot on the slide valve prevents the valve from moving and the coil spring changes length with the wheel stroke.

If a change in car level occurs, as by added passenger load, the wheel control arm departs from its designed position long enough to move the slide valve by displacing fluid out of the dashpot. Many other systems are possible, both mechanical and hydraulic. The complication involved is no greater than in several other devices now used successfully and the benefits are great.

Noise Level and Harshness

Many things contribute to the noise level and harshness of a car. We have conclusive evidence that the use of Torsilastic suspension springs is a considerable step in the right direction. Long swells in the road surface obviously are of little interest in this respect. As road irregularities become shorter and sharper, they telegraph up through the suspension system to a varying degree.

While the largest component of these impacts is usually vertical, there certainly is an appreciable longitudinal component and some transverse component. The rubber torsion spring forms its own bearings and completely interrupts the metallic path from the wheel to the chassis. It may be so installed as to permit the wheel to deflect slightly in any of the five modes of movement other than the vertical deflection – the major elastic translation.

There are practical limitations to the amount of breathing we either can or wish to give the wheel. In the present design, the front springs were purposely made relatively long and slender to raise

the natural frequency of the unsprung mass above wheel hop frequencies. The rear springs in turn were made relatively short and fat in order to provide softer transverse and longitudinal deflection of the rear wheels. It will never be possible to mount road wheels so flexibly as to eliminate all noise and harshness.

Part of the problem also belongs with the tire designer. In this design, we have made an effort to reduce unsprung weight; but we do so with a full realization that reduced unsprung mass means less tire deflection, since it is the anvil of unsprung weight that makes the tire deflect beyond the quasi-static rolling radius deflection. However, the single arm mounting of the front wheels is expected to aid in isolating the chassis. At the rear there is less experience available with the use of rubber springs on an independent axle. We have made some efforts to isolate both the road wheels and the differential from the chassis, best seen from the layouts.

The point of attachment to the chassis of both front and rear chassis suspensions was made as rigid as possible. This design does have a frame, but no effort was made to isolate the body from the frame. We believe better results can be had, where rubber springs are used, by local rigidity. This forces a greater absorption of impacts within the suspension system than the "defense in depth" method in which impacts are dissipated by various interruptions.

[4] See ASME Transactions, Vol. 63, 1941, pp. A-59-A-66: "Modern Passenger-Car Ride Characteristics" by R. Schilling and H. O. Fuchs.

Ride Considerations

The nominal dynamic rate of the front suspension is 76 lb per in., giving 8.5-in. nominal deflection with driver only and 9.2-in. nominal deflection with designed 4-passenger load. The nominal dynamic rate of the rear suspension is 82 lb per in., giving 7.2-in. nominal deflection with driver only and 9.3-in. nominal deflection with designed load. We wanted slightly more nominal deflection at the front than at the rear[4] but the large change in rear sprung load made it necessary to arrive at a compromise. Some road work will be necessary in establishing the optimum rates.

Wheel clearance or wheel travel was set at ±4 in. metal-to-metal for both front and rear. We should like a still greater amount of wheel travel and could get it easily in the front, but not so easily at the back because of universal joint angularity of the swing axle. Since the car is held always at designed height, we believe the 8-in. total travel will be enough.

This design is only one of many ways rubber torsion springs can be used in automotive suspension. As more engineers become familiar with this type of spring, we believe that the cumulative effect of their thought and skill will result in a constantly broadening field of successful application.

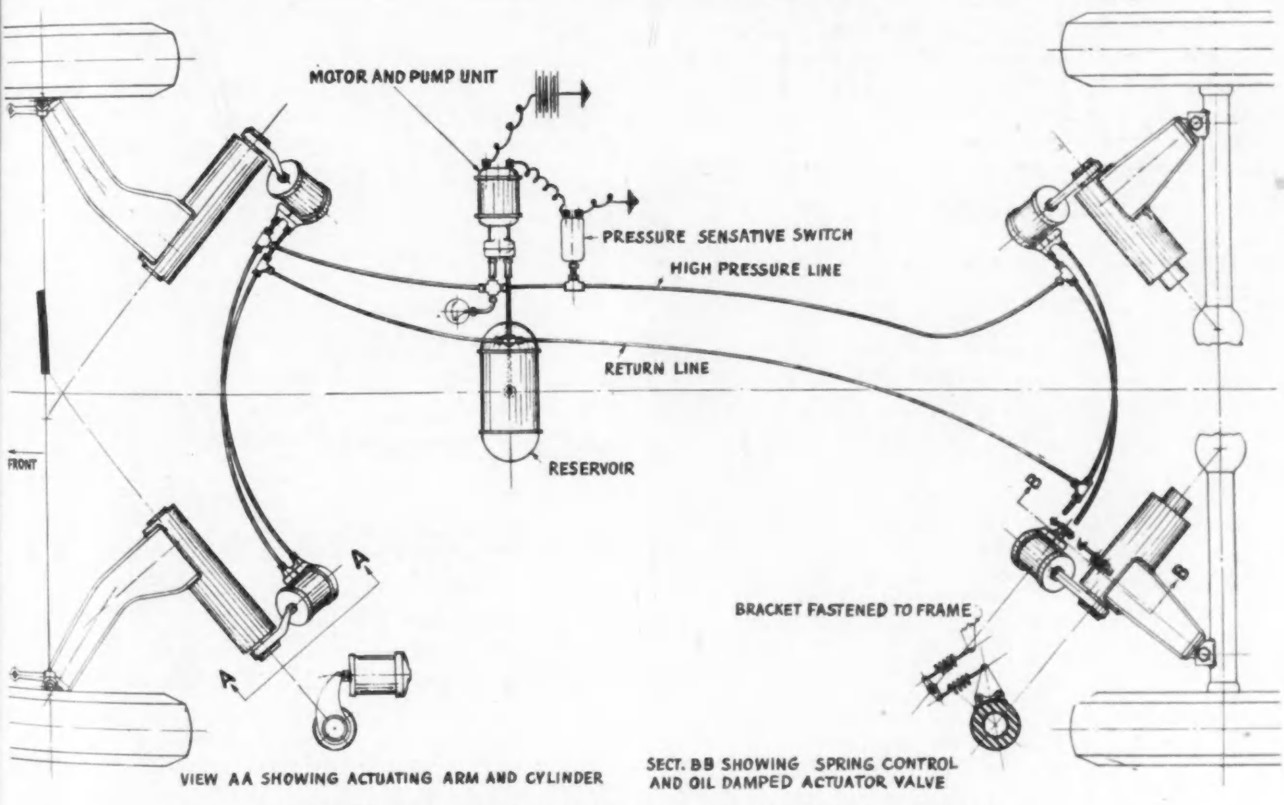
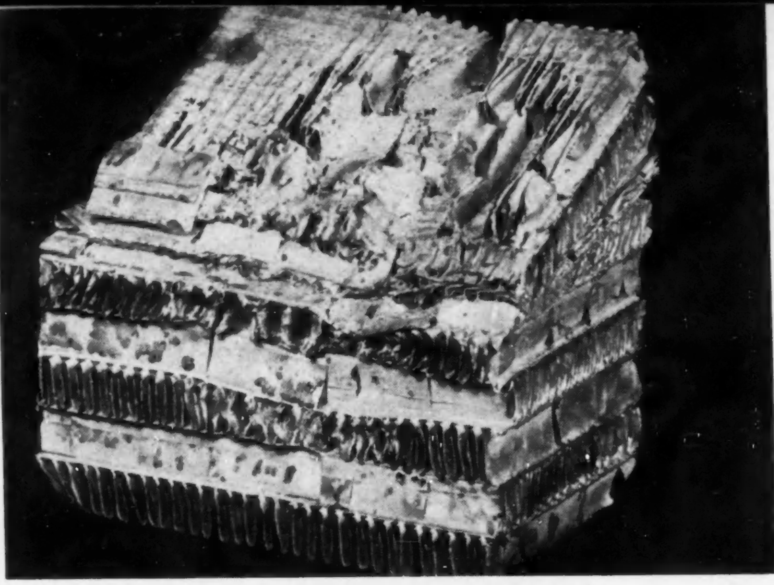


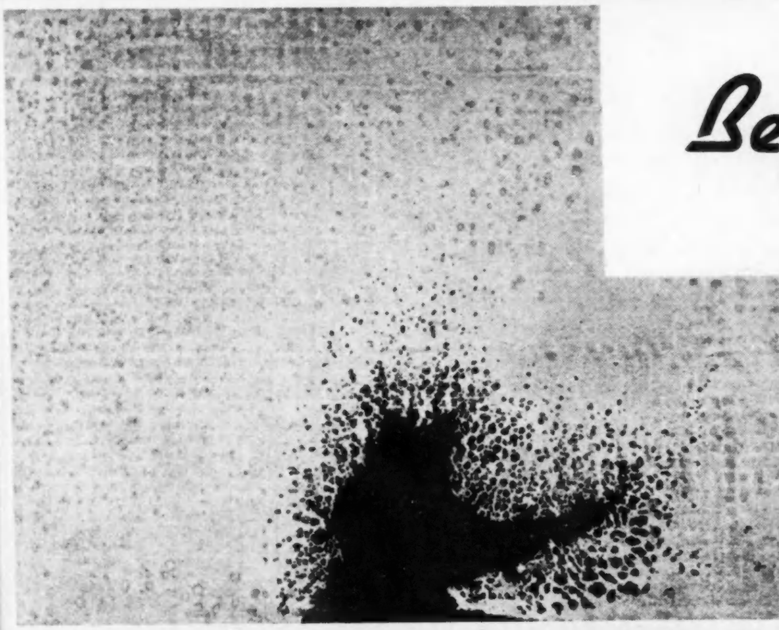
Fig. 11 – This constant-level mechanism is incorporated in all 4 wheels and holds the chassis at design level regardless of load changes



Aluminum

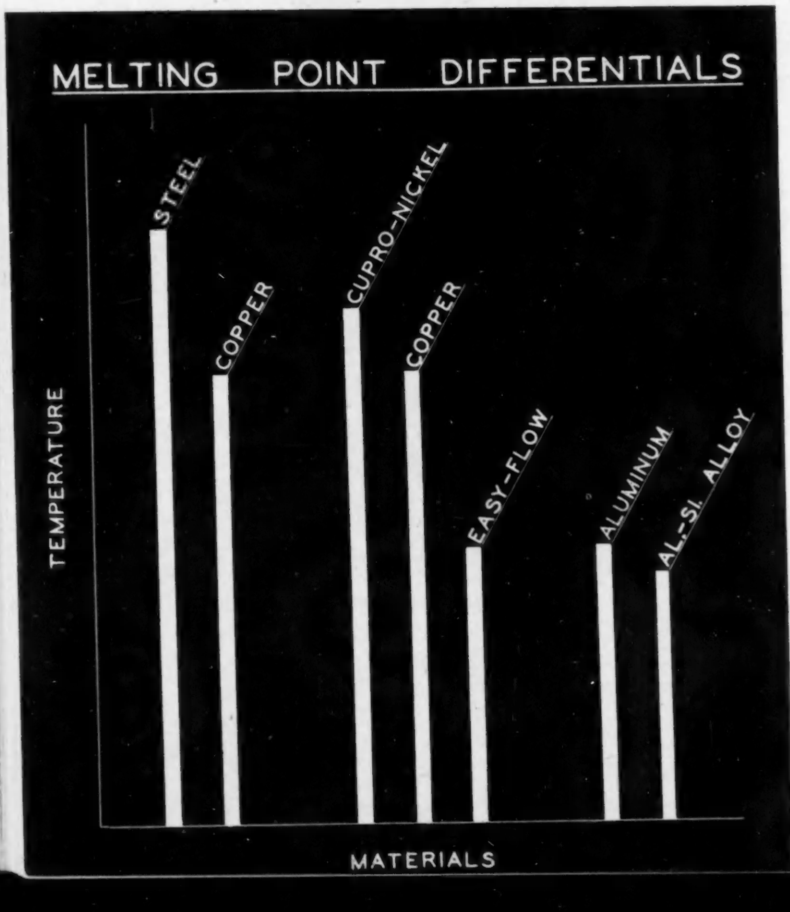
A Pictorial Technical

L. P. SAUNDERS



Before techniques and new furnace equipment were developed to manufacture parts, results of aluminum brazing in conventional bell furnaces were uniformly bad, as shown in upper left and left. Even when temperature was high enough to melt radiator tubes, little or no bond was made between centers and tubes. Flux reduced oxides as they formed, eventually exhausted activity of flux. Parent aluminum parts were continually oxidized by time and temperature, as shown by serious flaking.

products manufactured by the new process and furnace equipment, shown on the opposite page, indicate new design possibilities of aluminum parts. Authors credit Alcoa for technical cooperation.



equipment and methods developed to braze aluminum are shown on third to fifth pages of this illustrated technical review. On the opposite page are shown some of the aluminum heat exchangers successfully brazed. During the war 5,489,104 lb of brazed aluminum structures were shipped by the company.

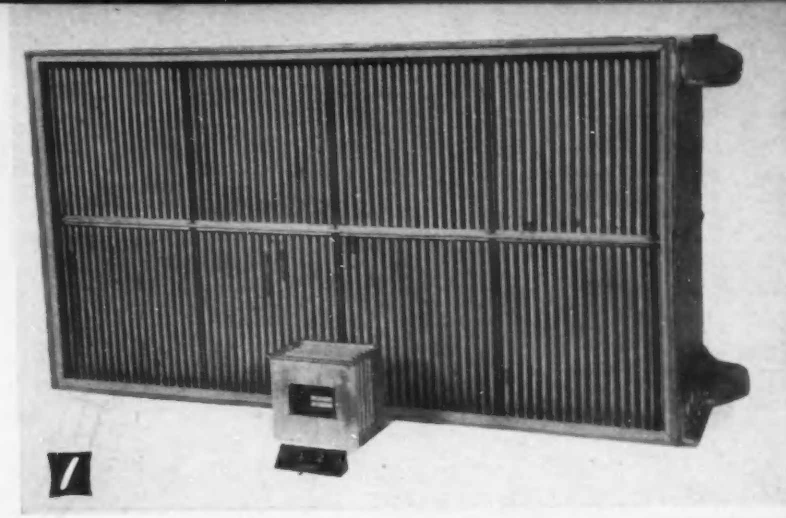
*Paper "Aluminum Brazing Development," presented at SAE Summer Meeting, June 5, 1946.

[1] Chief engineer of research engineering, and assistant section engineer, research engineering department, Harrison Radiator Division, General Motors Corp.

Brazing* . . . .

Review of a Paper by

and P. S. ROGERS[1]



1

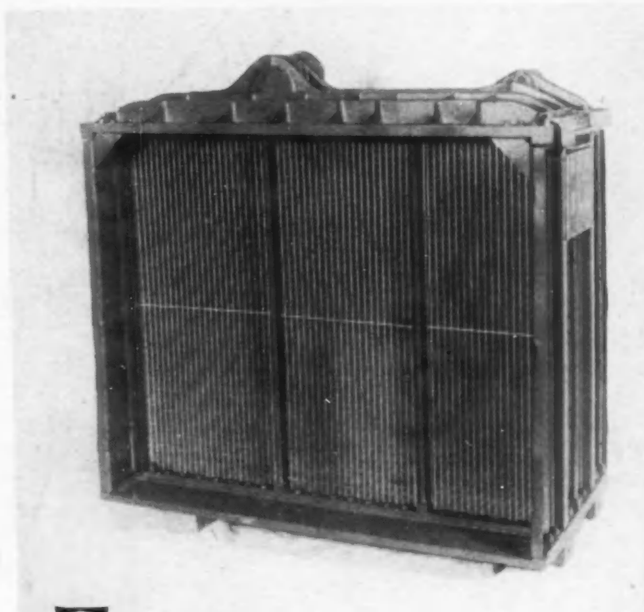
2

After techniques and equipment had been developed, production of aluminum structures was put on mass production schedules. Whether brazed in stages as sub-assemblies or as entire units, intercoolers came through. Under vibration tests, brazed aluminum structures stood up more than 100 times as long as did their soldered copper counterparts. Typical aluminum structures, successfully brazed, are shown on this page. These units passed the ANC-75 tests for internal pressure, thermal performance, and steam cycle.

1 Despite disappointments, results of aluminum brazed structures were successful. Here is an aluminum tube and fin radiator. Improved design is now possible.

2 Aluminum supercharger intercooler produced by the new brazing process, development of which resulted in reducing weight of structures by approximately one half.

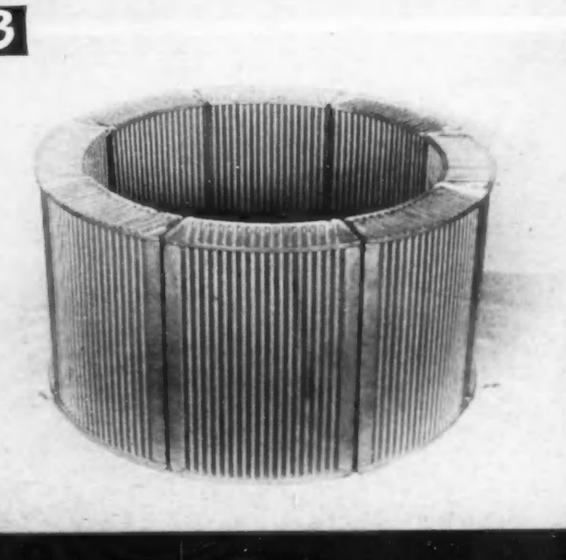
3 Aluminum extruded tube radiator produced in quantity by the new process. Current design limitations have been removed by the new technique, the authors said.

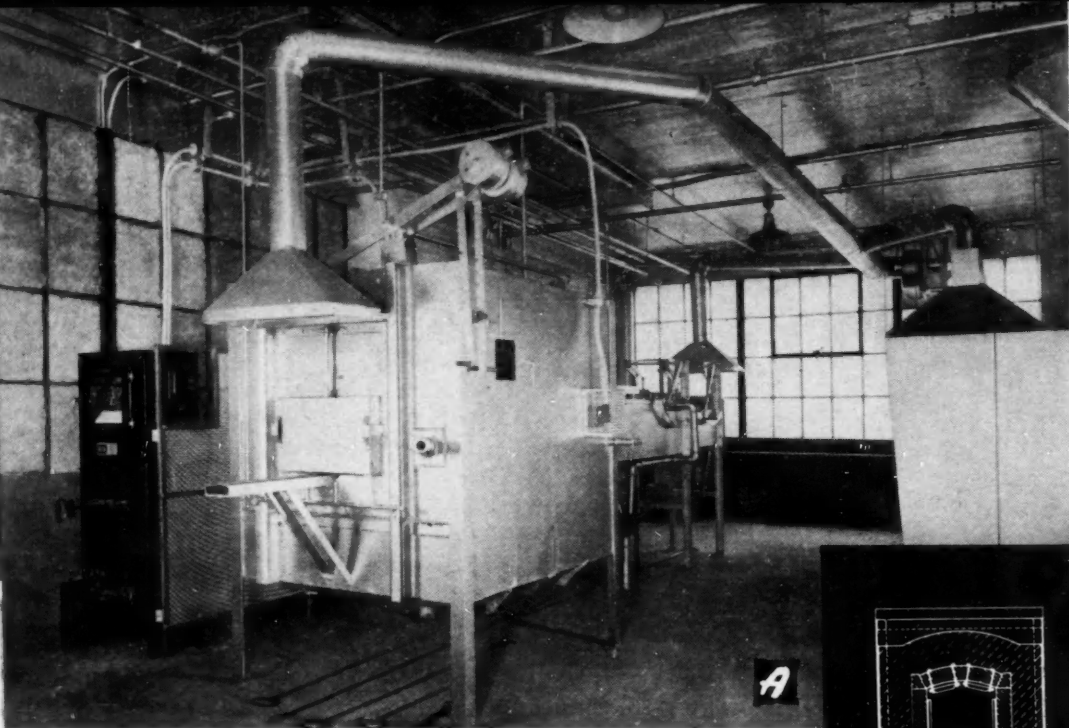


3

how aluminum brazing was accomplished

A graphic story of the development of a new metal joining technique and redesign of furnaces is told on the following three pages . . .





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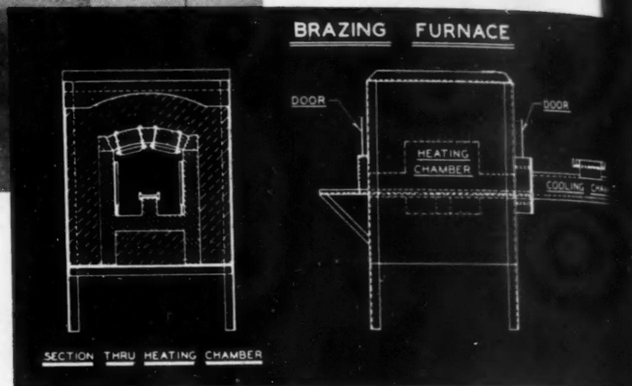

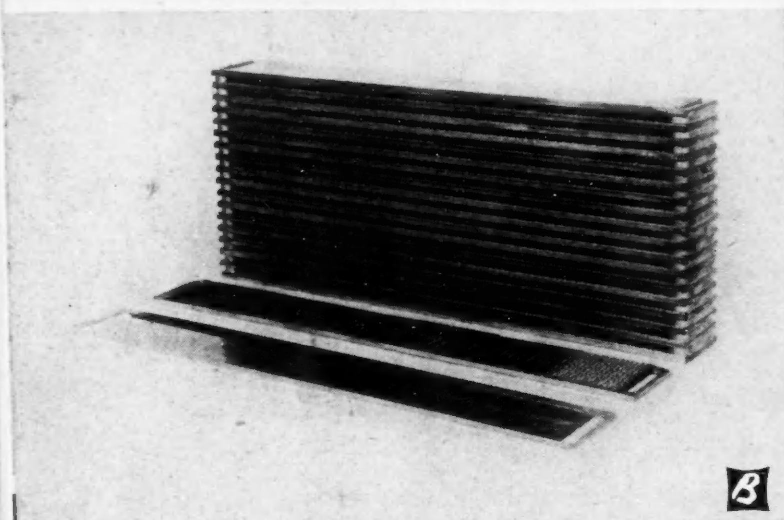

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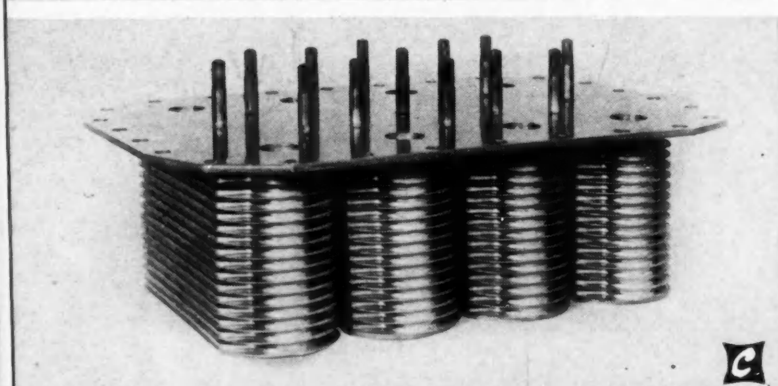

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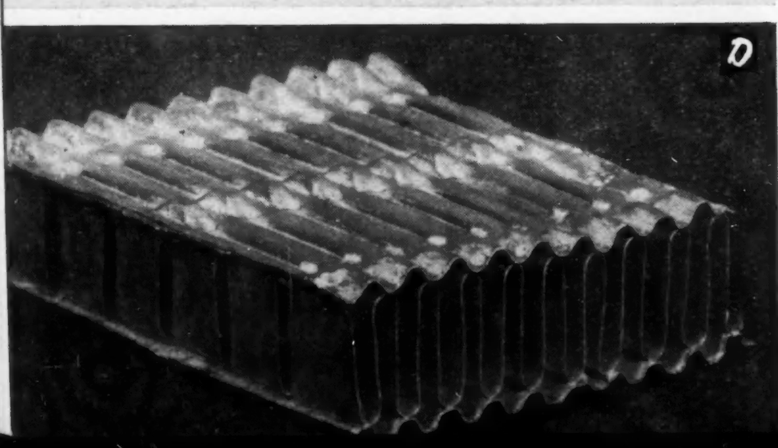


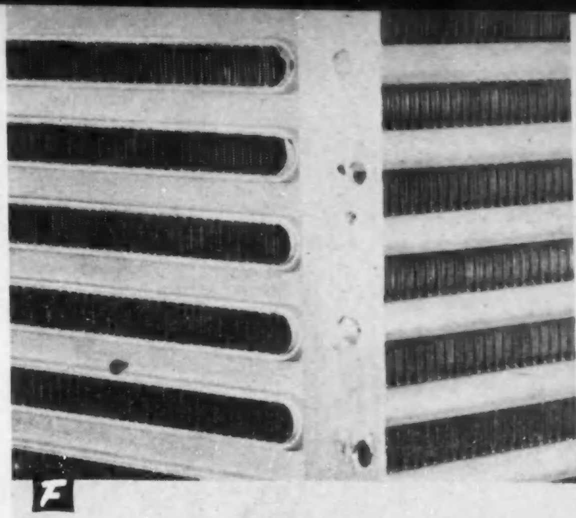
D

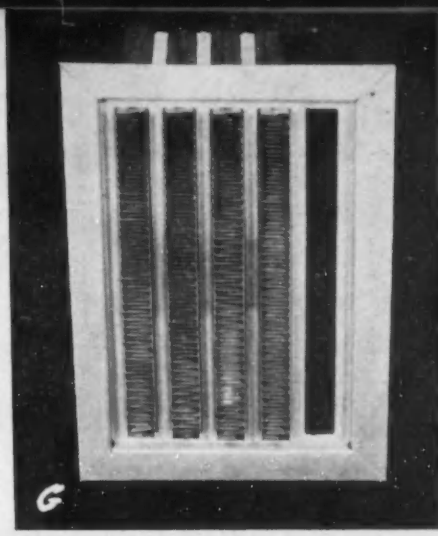
A Above to left is one of the 30 kw brazing furnaces, with schematic sketch. Peak load on 25 furnaces has reached 2500 kw capacity on 25 furnaces since 1935.

B Multitude of joints per unit is assembled with brazing material prelocated near or at joints. Sometimes brazed as single units, other structures are sent through furnace in gangs to be rebrazed into larger assemblies.

C Work on aluminum was begun in 1938. Copper brazed steel or cupro-nickel constituted production materials until aluminum was added. Soft soldering of aluminum was not successful for radiator or heat exchange units.

D Aluminum sheet stock (0.02 gage or less) formed in standard radiator core machinery was experimentally brazed with bond as corrosion resistant as parent metal. This started work on production method for aluminum brazing. Heavier gages are easier to braze, opening the door to many new design possibilities of aluminum of 0.06 gage and up.



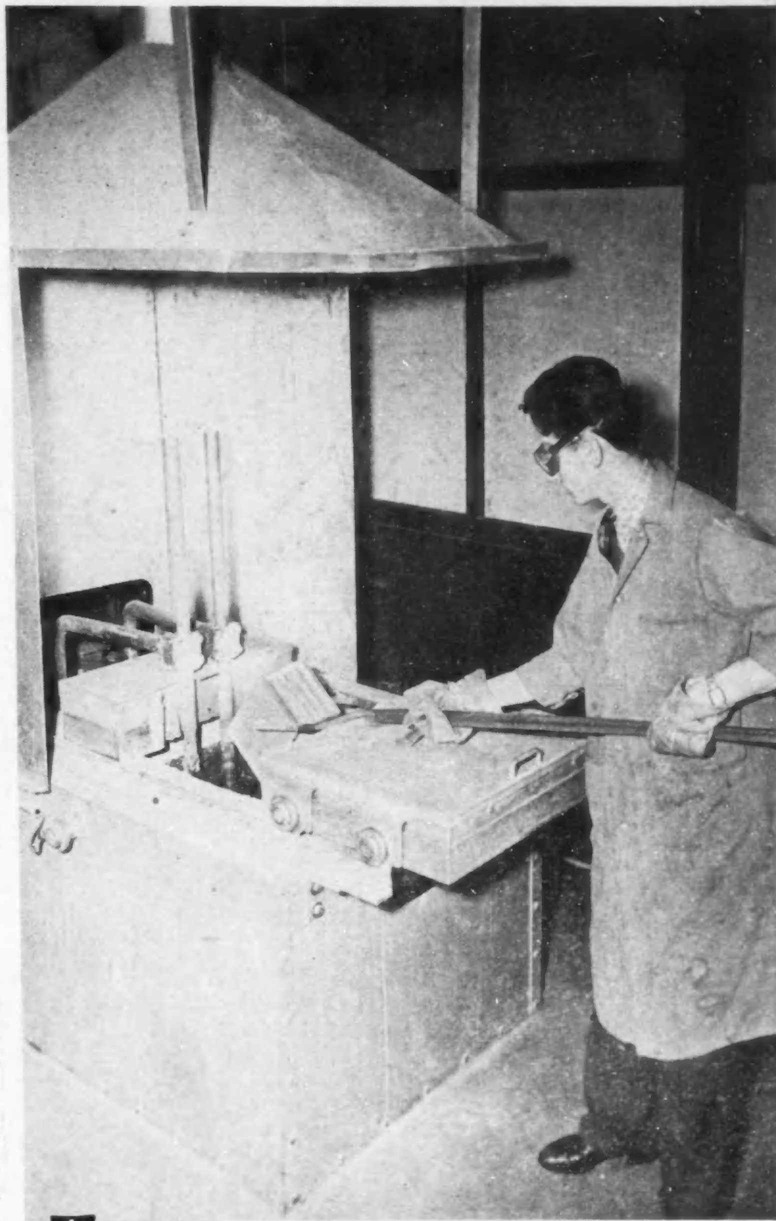


E Aluminum brazing sheet with core of manganese aluminum was used. Core was of lower melting point than brazing alloy.

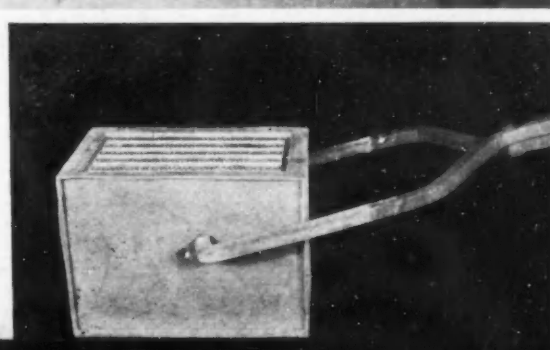
F Stamped or formed parts must have and must maintain good mechanical fits while being subjected to heat in furnace, as on this supercharger intercooler.

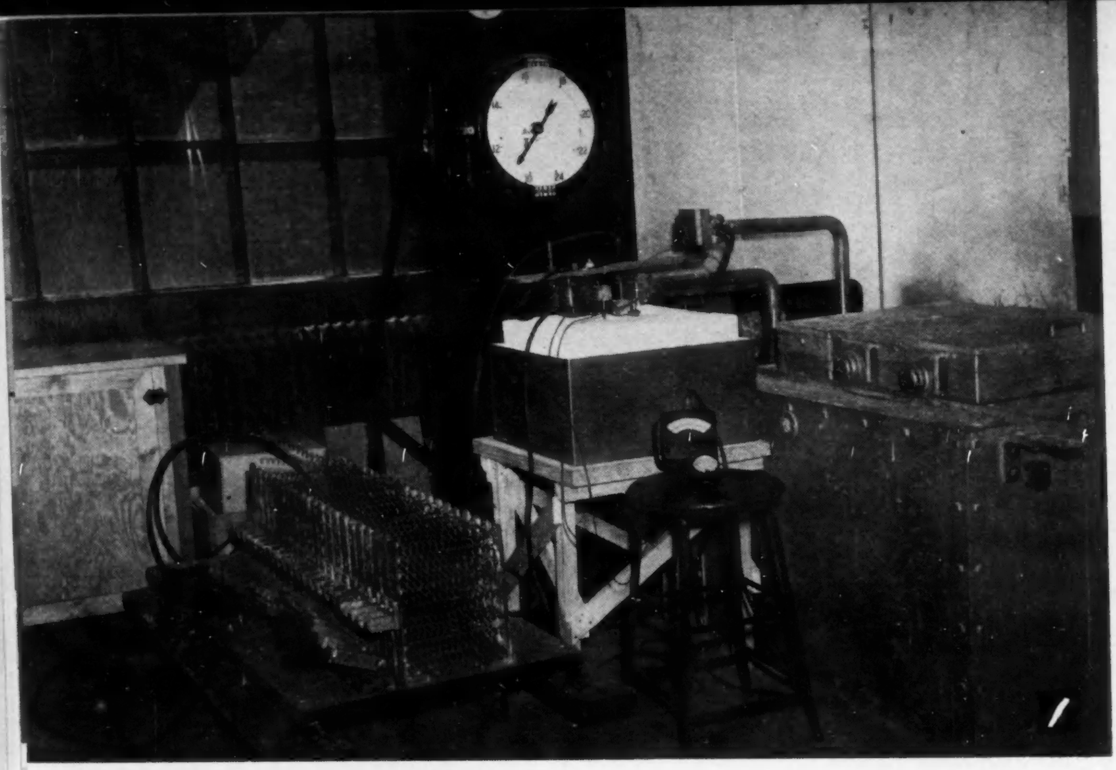
G Use of brazing sheets assures brazing material being properly preplaced. Round end tube intercooler ready for the brazing furnace with brazing material properly prelocated.

H First aluminum brazing experiments were run in electrically-heated Bellis salt bath. Iron pots and electrodes were replaced with nickel counterparts to eliminate ferrous contamination with molted flux. Fixture, below, was devised to hold unit tight to prevent warpage during immersion. Good joints depend upon physical contact between adjacent parts.

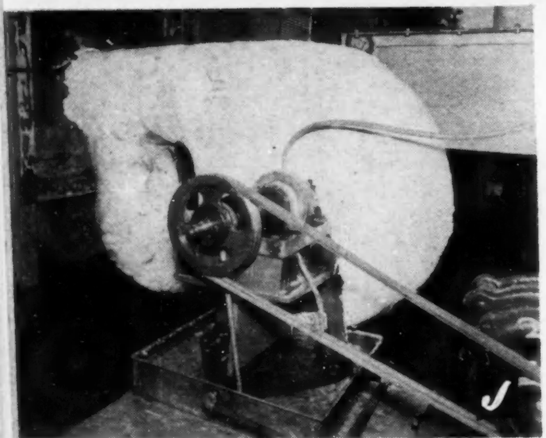


but troubles lay ahead when sludge formation was found after fourth core was dipped. In dipping, care was needed to prevent touching sludge or getting unit too close to electrode. Otherwise run-throughs occurred because salt had attacked nickel pot and electrode. In attempt to discover reason for sludge - whether it was formed from impurities of salt bath or some deleterious effect of 25 cycle electrical current - a series of experiments was run to determine effect of change of distance between electrodes and pot.

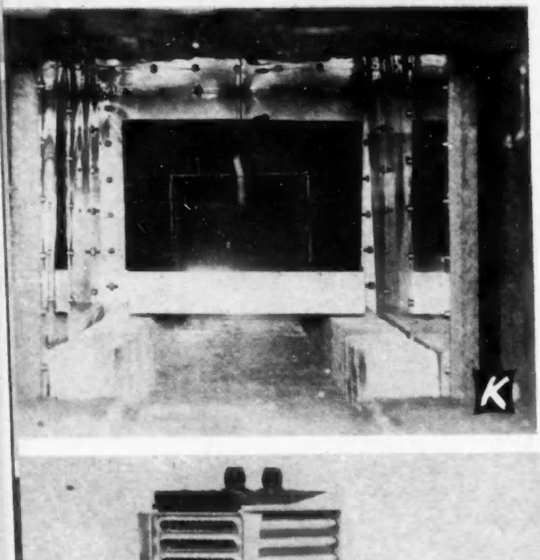




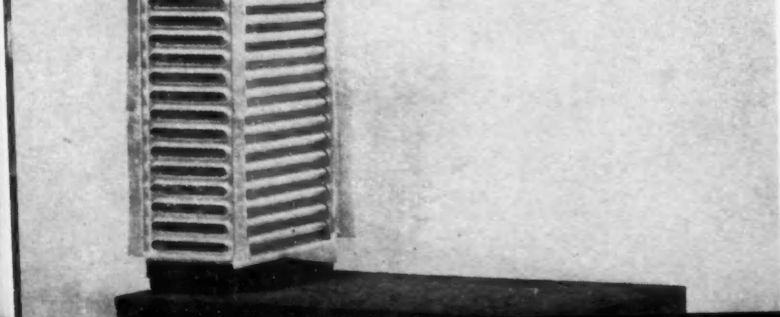
I Small nickel pot and electrodes were set up. Variable resistance was put in series with transformer on furnace. Voltmeter and ammeter were connected to give readings across electrodes. By weighing electrodes before and after each test, a corrosion factor was determined for each set of electrode spacings. Optimum distance was found to be equal between electrodes and pot in all directions.



J No. 6 American blower was substituted for small fan. This reduced brazing time from 25 to 10 min, with better results. But local over-heating continued run-throughs.



K Run-throughs occurred on larger units at outside edges of cores nearest heating elements. Local over-heating and resulting run-throughs were minimized by installing heat baffles, left.



L Careful cleaning by several methods was undertaken to produce better results. The subject of fluxes became a major research program. Time and temperature were varied until six minutes at 1130 F was established. But good results continued to be intermittent. Simplicity itself, in the form of a cold rolled steel plate with a thin asbestos sheet on top, solved the problem. This base, serving as a tray, cleared way for mass production aluminum brazing. It held the work together, and depending upon the structure to be brazed, sometimes another plate is used to keep the joints tight.

Air Power Keynotes Aero Meeting Sessions

"AIRCRAFT production is the key to victory in future wars!"

If your memory is good you'll remember reading the above lead sentence in the report on the 1939 SAE National Aircraft Production Meeting in Los Angeles. Not only was that statement prophetic – it still is! And it strikes the keynote of the recently concluded National Aeronautic Meeting held in Los Angeles Oct. 3-5. The highlight of the meeting came on Friday evening when Major-Gen. E. M. Powers, addressing a capacity crowd in the Biltmore Ballroom, said, "The first element of national strength is armed-strength-in-being. . . . Air Industrial Planning is the first milestone on the road to American security. . . . American production tipped the scales toward victory (in World Wars I and II). It is doubtful if any future aggressor will

ABOVE, left to right: A. E. Raymond, Major-Gen. E. M. Powers, SAE President L. Ray Buckendale, General Chairman A. L. Klein, and Rear-Admiral E. M. Pace, Jr., at the banquet speakers table of the 1946 SAE National Aeronautic Meeting in Los Angeles Oct. 3 to 5

BELOW: R. W. Cochran, chairman of SAE Southern California Section, left, with SAE Vice-President Charles Froesch and SAE President L. Ray Buckendale

forget this. For our own good we must not forget it."

The emphasis on planning for military production as presented in Gen. Powers' speech pointed up the undercurrent of attention to development of super air weapons which flowed through many of the engineering papers presented.

The dying echoes of warfare which currently mingle with rising fears of future air attack were emphasized by the coincidence that, as Gen. Powers spoke his words of warning at that Friday night session, newsboys outside the Biltmore were shouting headlines on the trans-Polar flight of the B-29 bomber "Pacusan Dreamboat" from Hawaii to Cairo. Perhaps no event in history has so clearly demonstrated that no spot, however remote, is now safe from attack. It was most appropriate that such a demonstration should coincide with the SAE meeting at which engineers were casting their thoughts far into a future of space travel, supersonic speeds, and atomic power. Bemused by the equally dread import of Gen. Powers' words and the Dreamboat's deeds, members were tempted to reach back into the report on the 1939 SAE meeting at Los Angeles and quote: "One felt, at times, as though the echo of bombs bursting in London streets could be heard there in the Biltmore Hotel, in Los Angeles." Only now the bombs one imagines have the reek of Hiroshima's one hundred thousand dead, and the blast of Bikini's battleship-crushing test. Such is the condition of our modern world as it was borne in on the thinking of many in attendance at the Los Angeles sessions of 1946.

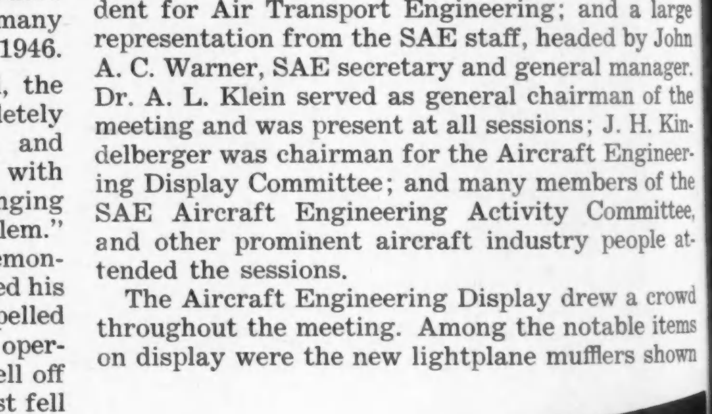
Fortunately for everyone's peace of mind, the twin highlight of the meeting was of a completely peaceable nature, fascinating, entertaining, and exciting. W. B. Stout followed Gen. Powers with a presentation of his amusing and challenging paper on "A New Approach to the Flight Problem." Stout favored the crowd with a personal demonstration of his "Geflopigator." He also operated his "Wirligigibus" with fly type wing, and propelled himself around on a rotating stool – through operation of his wing type fan – until he almost fell off the stool, while the pop-eyed customers almost fell off their chairs with mirth. His demonstrations were climaxed by the actual flying of a flapping wing model which he dubbed a "helithopter."

Stout's presentation was supported by high speed motion picture studies of bees, flies, and humming birds in flight, and by a Believe-it-or-Not picture entitled "Aeronautical Oddities" which was contributed by the Air Materiel Command. All of this was highly entertaining, but had an obviously serious purpose. While Stout disclaimed any intention of building a full-scale "flapping-machine" there were indications that he has by no means concluded his prolific and fruitful scientific experimentation in this direction. He made a serious plea for other scientists, preferably the youths just entering the field, to back-track 50,000,000 years and attack the flight problem from an entirely new approach, or more literally from the oldest of all approaches, that of insect flight.

A lively discussion session followed the Stout lecture and was topped by the exchange which took place when Harlan D. Fowler, of Fowler Flap fame, asked whether this new approach to flight might hold promise of man's flying under his own power. Stout had previously stressed the abnormal metabolism of the humming bird, with its enormous daily intake of food, so he shot back, "Sure – as soon as you learn how to eat five and a half times your own weight per day I'll guarantee you'll be able to fly under your own power."

When the tremendous postwar contraction in aircraft production is considered, the interest and attendance at the sessions was almost phenomenal and probably reflects something of the present undercover drive to push scientific and engineering developments in the field of supersonic guided missiles. In any event, the entire meeting was a success and did credit to all those who planned and helped conduct the sessions as well as to the four cooperating SAE Sections: Southern California, Northern California, Oregon and Northwest. Present at the sessions were: SAE President L. Ray Buckendale; G. A. Page, Jr., vice-president for Aircraft Engineering: Charles Froesch, vice-president for Air Transport Engineering; and a large representation from the SAE staff, headed by John A. C. Warner, SAE secretary and general manager. Dr. A. L. Klein served as general chairman of the meeting and was present at all sessions; J. H. Kindelberger was chairman for the Aircraft Engineering Display Committee; and many members of the SAE Aircraft Engineering Activity Committee, and other prominent aircraft industry people attended the sessions.

The Aircraft Engineering Display drew a crowd throughout the meeting. Among the notable items on display were the new lightplane mufflers shown



R. W. Cochran, chairman of SAE Southern California Section, left, with E. W. Rentz, Jr., SAE West Coast manager; George Tharratt, C. L. Johnson, SAE Vice-President Charles Froesch, E. H. Heinemann, T. Claude Ryan, John K. Northrop, and an unidentified diner

by both Ryan Aeronautical Co. and Solar Aircraft Co., while Solar attracted a great deal of attention with a showing of the stainless steel rocket motor as supplied for the Army's WAC Corporal high altitude rocket.

President Buckendale presided at a special dinner meeting for SAE leaders on Friday evening, and a large portion of the Southern California Section SAE membership turned out for the gala Banquet and Grand Ball on Saturday evening.

A total of 12 sessions was packed into the three days of meetings, with some 32 authors contributing to the 23 papers which were read before audiences averaging upwards of 100 persons and totaling more than 1500 for the full meeting, with an individual registration of approximately 800 SAE members and guests. Various papers dipped deeply enough into the developing fields of guided missiles, supersonic speeds, space travel, and atomic power to dramatize for those in attendance, especially a number of the older members, what a vast field is covered by the designation "automotive engineer." Some of those who were active in the engineering of early horseless carriages must have pinched themselves occasionally when consideration was given to atomic power.

The broad scope of the papers was nowhere better illustrated than in the sessions on transport aircraft air conditioning with discussion of the "odor scale" setting up measurements of human tolerance to odors, the determination of rate of water evaporation by an adult male, "Human Response to Vertical Vibration," and human requirements of fresh air in terms of cfm. As extrapolated curves were flashed on the screen, showing cabin air conditioning requirements up to 1000 mph, it was made evident that vehicles for human transportation are being converted into projectiles, or projectiles into vehicles. Total impression of all sessions was of the human mind plunging on deep into the unknown, but with full instrumentation, as in the case of our newest telemeter-monitored sounding rockets. Yet such is the pressure for military security, against the rising threat of an atomic war, that the future was seen publicly ouly "through a veil darkly," with a hint here and there as shown by a chart or table or brief phrase.

Underscoring the warning given by Gen. Powers on the need for air production preparedness was the paper entitled "Postwar Aircraft Industry Cashes in on Wartime Experience" given Saturday morning by Prof. Horace N. Gilbert, California Institute of Technology. Perhaps the most vital lesson of the late war, according to Prof. Gilbert, was that not a single U. S. airplane whose design was initiated after we entered the conflict, ever saw combat. He made it clear that, on the strength of all past evidence, any future war must be fought with the weapons at hand when war is declared. Prof. Gilbert conceded that engineers made great contributions to the development of existing types of aircraft but contended that all efforts poured into new projects were completely wasted so far as contributing to victory in this war was concerned. He felt that, for our future security, aviation management should give greater emphasis to engineering and relatively less to production, during our current period of reduced production. But he urged that steps be taken to preserve the vast store of production "know-how" which we developed during the war. While Prof. Gilbert referred freely to German aircraft production techniques he felt that, on the whole, they were no better than our own. A remarkable increase in fighter production had been achieved in 1944 by superimposing a select staff of competent German aircraft industry people upon the established corps of bungling professional bureaucrats who had been trying to manage aircraft production.

J. L. Atwood, session chairman, asked for an average figure on the cost of the first prototype of an American military plane. Prof. Gilbert estimated that it would run about $200 per lb as compared with a quantity production cost of only $5-$6 per lb. There is still no evidence, he stressed, of an engineering technique having been developed by which we could produce new aircraft, military or transport, direct from blueprints.

Most heavily attended of all day-time sessions were those dealing with jet and gas turbine developments. Great interest was shown in the paper presented by Franklin W. Kolk, American Airlines, on "The Future of the Gas Turbine in Air Transportation." Kolk was a bit on the Paul Revere side with his warning that "The British are coming" with jet powered transports unless we beat them to it. He pointed out that prop-jet powered planes currently seem to possess definite advantages for trans-Atlantic passenger service, and for domestic air freight operations. He presented a three-view drawing of a possible four-engine prop-jet transport which looked to be a turbo-powered version of the Republic Rainbow. However, he pointed out

G. A. Hufferd, left, Eddie Molloy, Brig.-Gen. Earl S. Hoag, J. L. Atwood, E. F. Lowe, former SAE West Coast manager, Earl D. Prudden, John C. Lee, Col. E. T. Kennedy, and W. Collins, who were among the diners at the Aeronautic Meeting Banquet

that fuel storage space was a serious problem which would have to be solved through provision of tanks in elongated engine nacelles, or in separate tank nacelles, perhaps located at the wing tips. He predicted speeds of 430-450 mph for his prop-jet transport, which is what is being claimed for the more conventionally powered "Rainbow."

This paper evoked a flurry of comment and discussion. Harlan D. Fowler asked if the engine nacelles could be eliminated entirely with prop-jet power. Kolk agreed that this could be done, somewhat after the arrangement of the DC-8, but felt the power to be absorbed through a single propeller would make it impracticable; and there would still be the need of nacelle space for fuel. An objection was made to the prop-jet unit on the count of high maintenance cost but as to this Kolk felt that high speed was a sufficient incentive to bear some added maintenance burden and furthermore the added cost, if any, would more than be made up by a saving in fuel costs. Carlos Wood, of Douglas Aircraft Co., Inc., suggested that the real advantage of the prop-jet application would come from operation at high altitude but Kolk felt this avenue of progress would be hampered by the compressibility effect. Reagan Stunkel, of Lockheed Aircraft Corp., questioned the ability of our present traffic control systems to handle trans-oceanic aircraft coming in at 450 mph. Kolk felt that this problem could be solved through use of radar and other advances being made in traffic control, plus giving trans-ocean planes approach priority over domestic aircraft of shorter range and less critical fuel load conditions.

A bright future was foreseen for the pulse-jet engine by L. B. Edelman, "Project Squid," Princeton University, and formerly with the U. S. Navy, in his paper "The Evolution of the Pulsating Jet Engine." Admitting that this type engine is hampered by noise and vibration, Edelman feels that it has great possibilities nevertheless due to light weight, simplicity, and efficiency approaching that of current reciprocating engines. Again considerations of military security apparently prevented Edelman from revealing even more significant information on this type engine but it was hinted at in his concluding statement that "Past work on this type of engine, both abroad and in America, has been such that the results to date are of only preliminary importance. Barely a start has been made on the sizable improvements expected, and the field is almost incomparably rich in possibilities for creative endeavor."

Dr. J. F. Manildi, of the G. M. Giannini engineering staff, asked for an opinion on the performance of pulse-jet engines at supersonic speeds.

Edelman replied that he thought the pulse-jet might be superior at least to Mach No. 2. William Goodman, also of the Giannini engineering staff, volunteered confirmation of Edelman's estimate as to the prospects for the pulse-jet engine. Dr. Norton B. Moore, Aircraft Division, Willys-Overland Motors, Inc., asked what had been done to reduce noise and vibration. Edelman admitted that little progress had been made to date along such lines but felt that progress might be looked for employing a bank of cylinders with mechanical phasing of firing.

Chairman A. L. Klein of the General Committee, left, with Ralph R. Teetor, SAE Meetings Committee chairman

The head table at the Aeronautic Meeting in the background of the U-shaped table arrangement

A paper on "Automatic Control Considerations For Aircraft Gas Turbine Propeller Power Plants," by C. W. Chillson, G. P. Knapp, and M. Meyer, Propeller Division, Curtiss-Wright Corp., served chiefly to point out that there is a serious problem posed by the poor acceleration and deceleration characteristics of the prop-jet type powerplant. No final solution was suggested but it was thought that an approach might be made through automatic propeller feathering control.

"NACA Research on Effect of Combustor-Inlet Conditions on Combustion in the Turbojet Engine" by J. Howard Childs, Richard J. McCafferty and Oakley W. Surine, Cleveland Laboratory, NACA, was a scholarly contribution to the existing data on combustor performance, confirming the known loss of efficiency with progress to higher altitudes.

In the sessions on Transport a particularly significant paper, "The Effect of the New Civil Air Regulations on Scheduled Air Transportation," by R. W. Ayer and F. F. Fennema, American Airlines, Inc., was read by F. W. Kolk. This paper

discussed the new CAA *T* category rules, or *yardstick* design formula which has replaced the arbitrary stall speed limit which has controlled air transport design for some years. The authors contend that safer aircraft will be developed under the new rules, and that the cost trend will now turn downward in cost per airplane mile as transport speeds go up, at least to the neighborhood of 400 mph.

The place of the turbo-jet in the transport field, and the possible use of rocket and atomic power units, was outlined in a paper "Designing to the New Transport Category Performance Requirements of the Civil Air Regulations," presented by W. Bailey Oswald, Ph.D, Chief of Aerodynamics Section, Douglas Aircraft Co., Inc. Dr. Oswald forecast transport speeds of 450-550 mph for the relatively near future, and suggested this would be accomplished with aircraft of conventional layout except for the probable use of sweptback wings. He reported that the present CAA performance requirements can be applied, with minor revisions, to all aircraft operating in the subsonic range but that application of rocket and atomic powerplants would require considerable modification in the regulations governing design of transport planes.

Pointing out that weight saving, if accomplished at the expense of passenger comfort or maintenance efficiency, can be prohibitively costly, the paper "Weight Saving Can Be Expensive" by B. J. Vierling and Lan H. Caldwell, PCA, and read by Walter H. Flinn, PCA superintendent of engineering, provoked substantial discussion and some disagreement in emphasis. F. W. Kolk took issue with the authors on the difficulties cited concerning leakage of integral fuel tanks. Kolk said this problem had been solved. Howard F. Schmidt, Consolidated-Vultee, commented that their integral tanks had been 100% satisfactory. E. F. Burton, Douglas, chairman of the session, said he wasn't too sure that the integral tanks would be kept as a feature of the DC-4, which left the question right back where Vierling, Caldwell, and Flinn had spotted it. George Buckner, Douglas, suggested that most weight problems could be solved without penalty through careful, thoughtful, practical engineering design study. A suggestion from the floor to the effect that we might be missing some good weight savings bets by not cutting the weight of some of the parts that are *not* giving trouble brought one note of agreement from an engineer who reported saving 900 lb on one weight study, but a chorus of voices rose to suggest that we are having so much trouble beefing up parts that aren't satisfactory that we'd better not go out of our way to cut the weight of those which are not giving trouble.

"The History and Development of the B-29" was presented by E. C. Wells, Chief Engineer, Boeing Aircraft Co. Pointing out that the B-29, when first placed in service, carried only one-fourth of the bomb load eventually handled satisfactorily, Mr. Wells showed what could be done by careful study of the operating conditions under which the B-29 had to work, and also what weight savings it was possible to incorporate as the B-29 continued in production. He also commented that the new B-50, developed from the B-29, will have substantially greater performance in every respect.

Although the simplification program on the Republic SeaBee has already been widely publicized, the paper "Simplified Structures For Low Cost Airplanes" by Alfred Z. Boyajian, Structures Project Engineer, Republic Aviation Corp., proved of great interest. Promising reductions in airframe fabrication to as little as 10%-20% of conventional designs, Boyajian pointed out that whereas present aircraft production costs are running about \$5-\$6 per lb, the automobile people are putting out cars for as little as 20¢ per lb. His paper was well illustrated with drawings of the simplified SeaBee structures and he testified unreservedly to the increased strength, greater serviceability, and lighter weight which had resulted from the simplification program. Discussion brought out the opinion that simplified design could be applied to very large aircraft as well as small planes, and that simplified tooling actually was cheaper, even for relatively small quantities of planes.

How the Republic "Rainbow" is going to carry 46 passengers at 400-450 mph at 40,000 ft altitude for a range of 4000 miles in perfect comfort was the subject of Philip E. R. Brice, chief powerplant technical engineer, Republic Aviation Corp., in the paper "Factors Affecting the Design of the Air Conditioning and Pressurizing System for the Republic Rainbow Airplane." Brice tended to agree with Bruce DelMar, of Douglas, that 20 cfm of fresh air per passenger was ample, but also agreed with the Lockheed Constellation air recirculation and purification technique, as outlined by Bernard L. Messinger, of Lockheed.

The Douglas DC-6 air conditioning system relies on 100% fresh air and a somewhat lower rate of circulation according to the paper "Analysis of Transport Aircraft Cabin Air Conditioning Requirements With Special Reference to Air Freshness, Temperature, and Humidity Control," as presented by Bruce E. DelMar, mechanical test engineer, Douglas. In discussion on this paper, B. L. Messinger, of Lockheed, stated that humidity is not related directly to re-circulation and claimed that the re-circulation principle cuts down air stratification in the passenger cabin, reduces the temperature gradient, increases air flow, and provides better odor control. Both DelMar and Messinger commented on the problem of keeping the ducting system clean and preventing absorption of moisture by fabric and sound proofing.

Air conditioning was presented from a somewhat different and more unconventional standpoint with the paper on "Air Conditioning of Turbine-Pro-

continued in page 111

Stretching the fuel dollar for most economical aircraft performance is a basic "must" in competitive airline operation. Mr. Kent's description of how the AAF obtained the most in performance for the least in fuel with the B-29 applies as well to commercial operation.

■

Cyclone 18

OPERATIONAL engineering is responsible for improving the performance of the Cyclone 18, or R-3350, engine and developing the most efficient ways to use the B-29 as a weapon.

In the military sense, operational engineering might be defined as the science whose primary purpose is to develop and establish procedures of operation for a particular group of aircraft that the greatest possible bomb load may be carried to a given target over a given period of time. Its civilian application is to establish operating procedures that the greatest possible payload may be transported annually.

When the Cyclone 18 carried the first B-29's into combat over Bangkok, Thailand, on June 5, 1944, it had a history of some 17,000 hr of test stand and flight testing development together with a year of non-combat operation during training in the United States. The list of design changes to airplane, engines, propellers, and accessories is a long one. Improvements in design and maintenance techniques during this period were reflected in an increase in the "engine hours at removal" from an average of 120 hr in early 1944 to approximately 280 hr by mid 1945.

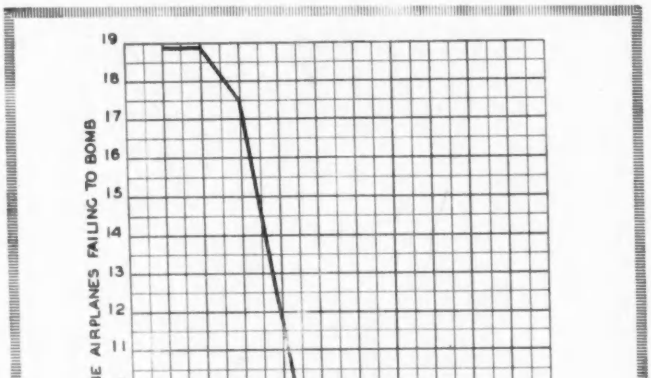


Fig. 1 – Chart demonstrating how the failures to bomb primary targets due to engine and airplane mechanical malfunctions were reduced by design changes

A 280 hr operational period before removal is a respectable average for a combat engine. Especially is this an imposing record under conditions where maintenance expediency frequently dictates rapid engine replacement rather than loss of precious time diagnosing an elusive trouble or performing a time-consuming repair.

Similar improvements were simultaneously being effected by manufacturers of the B-29 airplane and its accessory equipment. Whereas airborne airplane difficulties ascribable to maintenance and mechancial troubles made 19% of all sorties ineffective against primary targets during Nov., 1944, as shown in Fig. 1, this had decreased to a commendable 6% by March, 1945, and never again exceeded this value. Many of these airplanes, it should be noted, bombed secondary targets when malfunctioning kept them from bombing the primary objective.

Up to March, 1945, the airplanes were being flown in accordance with operating instructions based on data obtained from various specifications and flight tests made in the United States. The idea of carefully controlled flight testing in combat areas under combat conditions was originated by the 20th Air Force. While it now seems very obvious and simple, as good ideas often do in retrospect, the origination and successful execution of the idea reflect no small credit on that organization.

A production B-29 airplane was equipped with complete test instrumentation in the United States and, after complete calibration of all instruments, was flown to the Marianas in March. Instrumentation included torquemeters, bmep gages, exhaust back pressure gages, metering suction differential gages, fuel flow meters, sensitive tachometers, and cowl, oil cooler, and intercooler flap position indicators on all four engines.

The initial test objective was to obtain a thor-

BOUNCING-PIN INDICATOR

Silver Birthday

1921

1946

Excerpts from Paper by **T. A. BOYD***

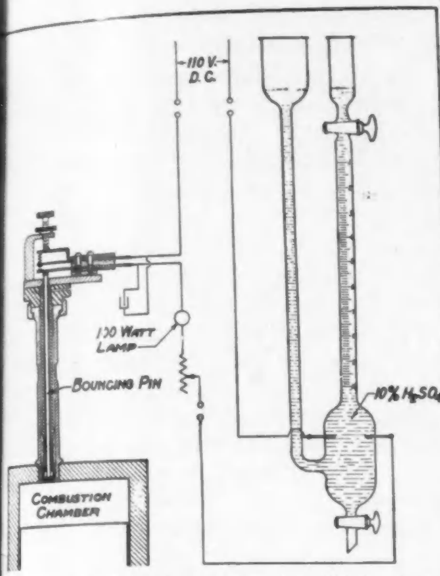


Fig. 1 – This diagram of the bouncing pin-indicator as developed in 1921 shows the pin arrangement, contacting mechanism, electrical circuit, and electrolytic cell for integrating current flow in a given time – such as one minute

It was in 1921, just 25 years ago, that the bouncing-pin indicator was developed. In spite of its shortcomings and of the circumstance that much intelligent effort has been put forth through the years to get a better instrument, the bouncing-pin indicator is still being used everywhere in rating automobile gasolines for octane number, by the ASTM method, by the IPT method, and by the Research method. In modified form, it is used also for rating diesel fuels for cetane number or ease of ignition. So, in this year of the silver anniversary of the bouncing-pin indicator, a little of its history may be of interest.

In the spring of 1921 the long search in the General Motors Research Laboratories for a practical antiknock agent was just entering its final and successful phase. And a more precise means of measuring knock than had been available was thought to be needed for it. The prior discoveries that compounds of iodine, selenium, tellurium, and nitrogen, were antiknock agents, whereas compounds of chlorine, bromine, oxygen, sulfur, or carbon were either without effect upon knock or else made knock worse, caused us to suspect that there might be a definite system or a periodic function among the chemical elements in respect to effect upon knock. An extensive program of research was accordingly undertaken to find out whether that surmise was correct; for, if it were correct, it should give a possible means of pointing out the best antiknock agent among the elements.

In the search up to that time, the antiknock effects of the various compounds tested had been observed either merely by listening to the sound of knock or by viewing the indicator cards of the Midgley optical gas engine indicator developed

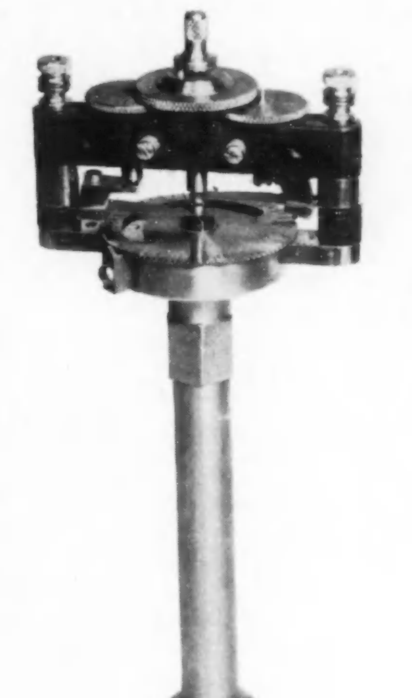


Fig. 2 – The bouncing-pin element as it is today. It incorporates results of the experience of many investigators

* Paper "The Bouncing-Pin Indicator is 25 Years Old," by T. A. Boyd, Research Laboratory Division, General Motors Corp., to be presented at SAE Fuels & Lubricants Meeting, Nov. 7, 1946.

previously.[1] While neither of those methods was free enough from the human element to be very precise, they had up to then served quite well the purpose of the search for an antiknock agent. But for the systematic and more extensive search now to be undertaken, where small differences in antiknock effect between compounds might be of real importance in showing trends, it was thought essential that we have a better means of measuring the antiknock effect of the compounds to be tested than either of those used up to that time.

In that search for a new and more precise means of measuring knock, we investigated first a temperature method. It was known that when knock occurred the temperature of the engine increased. In this method a thermocouple inserted in a plug screwed into an opening in the cylinder head of the engine was used to register the rise of temperature due to knock. But in our experience – or perhaps better to say in our little air-cooled engine – this temperature method could not be relied upon to indicate small differences in knocking tendency.

Origin of the Bouncing Pin

At a meeting of the Society of Automotive Engineers held about that time, Dr. H. C. Dickinson of the National Bureau of Standards happened to describe a simple device which he was using to detect whether an airplane engine was knocking, such engines being usually so noisy that the sound of knock was obscured too much to be observed by ear. That device, which Dr. Dickinson termed a "diddle pin," consisted simply of a free pin held loosely in a guide with its lower end resting on some part of the cylinder head of the engine. When knock was present, the cylinder head flexed so fast and so far from the violence of the explosion that it made the pin jump up off its seat momentarily. The height to which such a free pin jumped when the engine was knocking might in some cases be as much as 2 in. But, when knock was not present, the pin did not jump off its seat at all, but merely followed the rise and fall of the surface, whatever it may have been.

Attempt To Make the Bouncing Pin Quantitative

As used by Dr. Dickinson, that pin was essentially a qualitative device, used merely for indicating whether knock was present or not, although he did go so far as to calibrate it roughly in respect to maximum bounce. Thomas Midgley, Jr., who heard Dr. Dickinson describe his simple device, got the idea that the principle of it might possibly be used to solve our problem. And out of this came the conception that, if Dr. Dickinson's free pin were set inside the pressure element of the Midgley optical gas engine indicator with its lower end sitting on the spring-controlled piston, and if then it were suitably connected in an electric circuit, the amount of current flowing might possibly be used as a quantitative measure of the amount of knock. In the pressure element of the Midgley optical gas engine indicator[1] there was a light shaft which connected the piston in contact with the combustion chamber at the bottom of the element with the arm of a tilting mirror on the top of the unit. Conversion of this unit to a bouncing-pin element was made very simply by replacing the shaft and mirror with a free pin, located by guides top and bottom, as is shown in diagram at the left in Figure 1.

The first attempt was to use as contact points the lower end of the pin and the piston on which it rested and to measure the current flowing through them. But that did not work, partly because of fouling of the point of contact. Various changes were then made, and we arrived before long at an arrangement in which spring-controlled contact points were placed immediately above the upper end of the pin. In that first successful circuit were some dry cells, a resistance box, a Wheatstone bridge with potentiometer, and a condenser connected across the contact points. It is worth noting, too, that at that time the points were normally closed or in contact with current flowing, and that they were separated by the pin when it bounced upward.

From that point on the apparatus and procedure were consistently improved as the experimentation progressed. The contacting device was soon changed so that the points were normally separated, instead of being in contact as before, and so that they were closed only momentarily when the pin was propelled upwards by the surge which accompanied knock. The elaborate Wheatstone bridge circuit was then abandoned and replaced by a simple direct-current circuit with a suitable resistance incorporated; and, instead of a potentiometer, an electrolytic cell with means for measuring the gas generated during a given time by the current flowing. This change made it possible to use the ordinary 110-volt line as a source of current. The circuit, contacting mechanism, and pin arrangement thus arrived at in the first few months of use are shown diagrammatically in Figure 1. The bouncing-pin indicator as thus developed was first described in a paper presented at the Annual Meeting of the SAE in January, 1922.[2]

Such an instrument is of course suitable only for indicating the knock tendency of one fuel by comparison with that of another, and it can function only in the region of definite knock. It is thus a mere knock comparator and not at all an absolute measure of knock nor a means of indicating the point of incipient knock. Failure on the part of some to appreciate this limitation during the early days of the indicator sometimes caused it to be misused and therefore condemned as useless.

We realized, of course, that as a scale of refer-

[1] See SAE Journal, Vol. 6, No. 4, April, 1920, pp. 254-257: "High-Speed Indicators," by Thomas Midgley, Jr.

[2] See SAE Journal, Vol. 10, No. 1, January, 1922, pp. 7-11: "Methods of Measuring Detonation in Engines," by Thomas Midgley, Jr. and T. A. Boyd.

ence it would also be necessary to use fuels the effects of which were known. Experiments were accordingly made with various mixtures of benzene, ether, pentane, hexane, acetone, ethyl and methyl alcohols, and with antiknock agents of the aniline type. This not very successful work was perhaps one of the first efforts to develop a reference fuel scale. Nothing came of that effort from the viewpoint of a reference fuel for general use; but it was found that, for the limited purpose of our further search for an antiknock agent, an aniline scale or number – gotten by comparing the antiknock effect of the compound under test with that of aniline in a given fuel – would serve the purpose of our search quite well. And aniline was accordingly used as such a basis of comparison.

The Diaphragm Incorporated

The spring-controlled piston on which the pin sat in the original bouncing-pin element, as shown in Figure 1, had the defect that it permitted blow-by which sometimes gave gummy deposits on the pin, thereby making it sluggish, and also in that the piston would sometimes stick and thus interfere with consistency of operation. So, upon a suggestion first made by Robert N. Janeway – who at that time was a member of the staff of the General Motors Research Laboratories – the piston was replaced by a steel diaphragm of suitable thickness. That change cured the difficulty of blow-by, and it also improved the consistency of operation by preventing the occasional sticking of the piston.

The bouncing-pin indicator found a considerable use in the knock rating of fuels right from the time of its development. One of the principal places in which the instrument was soon used was in the several testing laboratories of the Ethyl Corp. And out of that use came two advances. The first of these consisted of various refinements in the construction of the bouncing-pin element which made it easier of adjustment and more consistent in operation. The second and more important advance was the development jointly by the Ethyl Corp. Research Laboratory and the Weston Electrical Instrument Co. of a time-saving replacement for the electrolytic cell used at first for integrating the reading of the instrument and making it quantitative. This is the device called the knockmeter, in which the current in the bouncing-pin circuit, as produced by knock, by flowing through a coil of resistance wire, generates a voltage in a thermocouple which is relative to the degree of knock and which registers directly on the scale of the instrument.[3]

Later the bouncing-pin indicator became a part of the original recommended practice for making knock tests first agreed upon by the Cooperative Fuel Research Committee in 1931.[4,5] This is the procedure which is now essentially the Research Method of rating fuels for knock, and out of which was developed by further work the present official method of measuring the Knock Characteristics of Motor Fuels.[6,7] The use of the instrument thereby became universal in the field both in this country and abroad. And this has continued ever since.

Long-Continued Use Remarkable

However, in view of the extensive verbal abuse from exasperated operators which the bouncing-pin indicator received on account of certain shortcomings it had, this long-continued use of the instrument has been a surprise to many, including those who had a hand in developing it originally. But the difficulties which were experienced with the bouncing-pin indicator – such as difficulty of adjustment, sometimes insufficient sensitivity, and occasional erratic behavior – caused many experimenters to try to improve it. This was particularly so during the 1930's. That experimentation was of two kinds: the first was an effort to modify the bouncing-pin indicator itself in such a way as to correct its shortcomings; and the second was an attempt to develop an altogether different instrument to serve the purpose. The outcome of those experiments was, in a word, that the effort to further refine the bouncing-pin indicator was reasonably successful, but that the attempt to develop a substitute for it was not productive so far as filling its place is concerned.

Prominent among the principles experimented with in the attempt to get an altogether new instrument, one that would be free of the shortcomings of the bouncing-pin, was that of the electromagnetic coil. One plan was to place such a coil immediately above the diaphragm and to amplify the change in reluctance as the gap was varied by the flexing of the diaphragm from the pressure of knock. In the experiments of some, the electromagnetic coil was even combined with the bouncing-pin in an effort to improve its behavior. Attempts to utilize electronic circuits were also made by different investigators in the search for an instrument better than the bouncing-pin indicator.

Among modifications of the bouncing-pin indicator itself which were experimented with were a plungerless type, a springless type, and a leverage type. But the bouncing-pin as used today, although benefiting from all these endeavors, is essentially a refined form of the original free pin with spring-

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[3] See National Petroleum News, Vol. 22, No. 8, Feb. 19, 1930, pp. 24-25: "New Knock Indicator Is Perfected by Ethyl Gasoline Corp.," by A. L. Foster.

[4] See SAE Journal, Vol. 29, No. 2, August, 1931, pp. 164-165, 168: "Tentative Recommended Practice for Conducting Anti-Knock Tests."

[5] See American Petroleum Institute Proceedings, 12th Annual Meeting, November, 1931, Sec. III, pp. 46-50: "The Cooperative Fuel Research Apparatus and Method for Knock Testing," by T. A. Boyd.

[6] Standard Method of Test for Knock Characteristics of Motor Fuels, ASTM Designation – D 357-45; American Petroleum Institute Standard API No. 532-45; Approved by American Standards Association as American Standard Z11. 37-45.

[7] See Standard Methods for Testing Petroleum and Its Products, published by the Institute of Petroleum, 1944, pp. 184-207: "Knock-Rating of Motor Fuel – I. P. Motor Method (I. P. – 44/44 (T)).

German Diesel-Engines

BASED ON A PAPER BY

C. G. A. Rosen*

Reveals German War-Diesel Aim

As Low LB Per HP at Any

THE main effort of Germany's wartime diesel research, according to C. G. A. Rosen, Caterpillar Tractor Co., was aimed at getting weight per horsepower down as low as possible. (Mr. Rosen was a member of the U. S. Naval Technical Mission which made on-the-spot investigations of German technical developments last year.)

The effort was relatively successful, his report indicates. One 16-cyl horizontally opposed marine powerplant, at least, weighed only 1.67 lb per bhp (bare engine weight).

The Germans tried a variety of methods to satisfy their obsession for lightness, Mr. Rosen says. They used aluminum and magnesium wherever possible. They stressed high-alloy steels to the limit of safety. They favored 2-cycle operation for small-bore, high-speed units because of its simplicity – and uniflow scavenging for the high-speed removal of burnt gases and the rapid filling of the cylinder with air. They avoided the poppet valve, some experimenters preferring the structurally more simple loop type of port scavenging.

Most important of all the methods used to step up power and bring weight down were the efforts to increase engine speed and bmep.

Much of the German success in developing engines that could be operated at high speed, Mr. Rosen feels, was due to concentration on reducing friction to the minimum. They used roller bearings; they designed their crankcase and main bear-

* Based on "Survey of German Diesel-Engine Development," by C. G. A. Rosen, Caterpillar Tractor Co., presented at SAE Summer Meeting, June 6, 1946. The unabridged paper will be published in SAE Quarterly Transactions.

Analyzed

ing structures so rigidly that extreme accuracy of crankshaft alignment was provided during operating stressing; they reduced ring and piston friction; they devoted much thought to designing power absorption by auxiliaries and accessories so as to yield net higher brake horsepower for a given indicated horsepower.

Supercharging was used even on 2-cycle developments to squeeze the last particle of air into the cylinder to increase the bmep. The trend was definitely toward the centrifugal type of supercharger, being driven either by direct gearing or by an exhaust gas turbine.

In large single-screw cargo ships, the piston type of scavenging pump was preferred, however, to make the main propulsion unit self-contained – which was permissible where space was not a serious factor.

Weight and space considerations, and, to some extent, noise, seem to have precluded the use of the Roots type of blower for high-speed naval engines.

Fatigue Testing

For bringing these design refinements to perfection, the Germans are reported by Mr. Rosen as having realized fully the advantages of laboratory tests.

One four-million mark laboratory for the study of fatigue, for instance, was built jointly by the German Naval High Command and one of the large diesel manufacturers. The laboratory was composed largely of crankshaft testing equipment, as the Germans placed particular faith in laboratory fatigue and dynamic and static stress studies on crankshafts.

Considerable research was done here on the elimination of "skip" or critical speeds in the operating range of marine diesels. To this end torsional stress values were kept sufficiently conservative to permit use of torsional vibration dampers when other design and installation characteristics failed to maintain sufficiently safe superimposed stress values.

The 20-cyl Daimler-Benz MB-511C – an outstanding 4-cycle supercharged lightweight diesel used on speed boats – had no vibration dampers on the crankshaft, the entire speed-boat installation being designed so as to avoid torsional critical speeds in the shafting and thus make the damper unnecessary.

Other German diesels used the Pielstick damper – a type valuable with large horsepower outputs, for it can be used either as a damper or as a coupling when making a "quad" installation by coupling four large units together to one line shaft, as means are required for isolating any engine at will by unloading the hydraulic type of Vulcan coupling. The torsional vibrations are damped by the absorption type of Pielstick coupling or, for greater effectiveness, by the Pielstick torsional vibration damper.

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BOUNCING-PIN BIRTHDAY

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controlled contact points above it. A recent improvement is shoulder suspension, in which the pin rests not directly on the diaphragm but on a ledge or shoulder above it, by means of which the narrow gap between the diaphragm and the lower end of the pin when at rest may be adjusted as required for best operation.

Thus, although the bouncing-pin indicator is still essentially the same in principle as it was when first developed back in 1921, many experimenters have had a part in bringing about the refinement of the instrument and in making it what it is today. And no doubt its long continuance in use is due in large measure to their efforts. Also in favor of the persistence of the indicator has been the circumstance that it is simple enough not to require highly technical attention for successful operation. Through the courtesy of the Waukesha Motor Co., present makers of the instrument, a photograph of the latest type of the bouncing-pin indicator element, as modified in accordance with all those efforts, is included as Figure 2.

The bouncing-pin indicator still has its shortcomings, to be sure. But these are not serious enough to keep it from serving very well indeed the purpose for which it is intended. And thus it will probably continue to be used – at least until something more perfect appears. Nevertheless, an even simpler and more trouble-free instrument would be welcomed by the many operators of knock-testing equipment. And efforts to develop such an instrument are still being made, the principal activities in that regard being centered in a group under the Coordinating Research Council.

Users Examine

Points of view on truck design by fleet operators in the eastern, central, and western states, and of another in city truck delivery service, were expounded in a symposium during the 1946 Summer Meeting.

Highlights of the four papers are presented here in a technical review.

Truck Designers Can Help Reduce Maintenance Costs

DESIGN and layout engineers in the truck companies and plants of component parts makers apparently have little idea of the excessive costs to fleet operators caused by the inaccessibility of components, these four papers agreed. If design engineers realized that the fleet operator must add the loss of revenue caused by a truck standing idle to the actual cost of labor, parts, and supervision, these authors believe, the paramount problem of inaccessible components would be on its way to solution.

The operators expect that the trend of skilled labor wages will increase, rather than turn downward to pre-war levels. None see any reversal of rising materials prices. Common carrier tariffs are fixed by Interstate Commerce Commission rulings, and proposed increased charges for hauling freight are slow to materialize.

Two speakers suggested instrumentation for making visual checks of wear of brake lining. Another pointed to the desirability of a fuel pump pressure gage and fly wheel markings shown in several degrees to indicate to the mechanic how far timing is off.

Built-In Visual Inspection Aids

More instrumentation, with built-in attachments for using them, would materially reduce cost of truck maintenance, Mr. Chaddick said. A tee, permanently installed on the pressure side of the fuel pump, would suffice. The mechanic would remove the plug, put on the adapter, attach a simple pressure gage, start the engine, read the pressure, remove the gage, and put the plug back in. This would take five minutes, instead of the usual 20 to 30 minutes now required to take the pump out, take it to a test bench, check it, and reinstall it. The pump connections would suffer no damage if the test job could be done as the author suggested.

Fixed aligment marks on front and rear axles would permit quick checking with a steel rule. The average truck operator cannot afford expensive floor equipment to check wheel alignment, two speakers pointed out.

Perches should be provided on rear bearings of transmissions and on pinion bearings of differentials to form a seat for dial indicators. Side and end play of these bearings could be checked quickly.

The maintenance mechanic should also have a quick means of visual examination of the remaining thickness of the brake lining. One speaker commended the Warner Electric and Bendix developments which indicate that the lining wear has about reached its limit.

If all truck and tractor units were set up for inspection of components, a competent check could be made in 2 hours, instead of the eight to 12 hours usually required for these periodic inspections.

Far From Standard Practical Vehicle Is Mostly "Special"

List prices for trucks are without meaning for the "for-hire" fleet operators, which have become an important factor in the motor truck industry's annual market, it was argued at the symposium. The customer and salesman agree that the engine should be about an eighth more powerful; a larger engine calls for a larger axle; this calls for heavier transmission and clutch. Springs will need extra leaves, and larger tires and rims become a "must," as do heavier brakes. Thus the $2000, less the fleet owner's discount, quickly gets to a net figure of about $3000.

Several speakers agreed that manufacturers specify adequate components for the vehicle that should be used in the first place. Dragging the "red herring" of too low a price wastes time, one complained. Three speakers agreed that, despite higher initial costs, "extras" are essential in highway transportation equipment.

Driver Is Considered

Operators of fleets are increasingly aware of the fatigue, strain, and possible confusion that may reduce the truck driver's efficiency. Although a standard vehicle was not visualized, three of the speakers felt that more standardization should be considered in respect to arrangements of instruments and controls on dashboards. Drivers are often transferred from one vehicle to another, and utter lack of standardized arrangement, as well as lack of uniformity in transmission shifting patterns, is a source of confusion.

Clutch pedal effort required of a driver on one truck should be approximately the same as on another vehicle, one of the authors said. The same

Truck Design*

Authors of the four papers in the symposium were:

- Ted V. Rodgers[1]
- H. F. Chaddick[2]
- J. L. S. Snead, Jr.[3]
- Willard D. Bixby, Ralph M. Werner and Harvey Earl[4]

force and travel should apply to all brake pedals. Steering wheels should be of uniform size, and their location with respect to the front left corner of the windshield should be similar.

This lack of uniformity and poor heating and ventilating were generally agreed upon by the speakers as being an indirect source of accidents and a direct cause for labor unrest in the highway transportation industry.

Mr. Rodgers pleaded that the driver's job should be made as easy as possible "because the industry wishes to enlist competent and intelligent Americans into the business." The trucking operators are not interested in the old type strong-back and weak-minded driver, he said.

Economics Of Light Materials

Mr. Snead emphasized the need for decreasing the unladen weight of vehicles operating in western states. High unladen weight, he said, puts a premium on increased loading space as well as gross weight limits. Pointing out the need for careful training of mechanics who are called to work with aluminum and strong steel alloys, he called attention to the resulting increase in maintenance costs. Despite this, he said, not only more truck bodies, but hubs, brake shoes and anchor brackets, shields, cams, and diaphragm brackets of the brake system, axle housings, gear cases, spring hanger brackets, shackles, torque arms and their brackets, clutch and fly wheel housings, transmission covers, engine supports, trailer fifth wheel, and frames are appearing in aluminum.

Although a greater difference between a loaded and empty vehicle accentuates the braking problem, he believed that the economics of highway transport in the western states should be attacked, at least in part, in terms of lighter materials.

Perhaps the emergency brake is the most difficult phase of the general braking problem in mountainous terrain, three speakers concluded. Present designs are wholly inadequate to hold a loaded combination on many mountain grades, and Mr. Bixby finds the same true in metropolitan areas.

Cite SAE Aid To Engineering

Simplicity of design – especially to help reduce maintenance costs but also seen by several authors of the symposium as being a factor in reduction of original outlay for equipment – appears to be the paramount design consideration of motor truck fleet operators from coast to coast. Several cited the standardization program of the SAE and its achievement through the years.

All agreed that many components of current design were unnecessarily complex, and two cited the design error of too many parts in a unit when fewer would serve better.

Citing the importance of "extras" and their high cost in relation to standard truck chassis, Mr. Bixby and his co-authors believe that the industry should survey its own needs and submit a list of the important units to truck manufacturers. If operators become aware of the value of such "extras," and the demand for them increases, costs would be reduced through mass production, they pointed out.

Trailer Chassis Lack Uniformity, Speakers Agree

Due to the sudden growth of the use of trailers in highway transportation, several speakers pointed out, trailer chassis are in dire need of careful engineering consideration by the manufacturers. The chassis lack uniformity, their components are seldom interchangeable, and detailed design is overly complicated.

Together, the speakers who touched on this problem concluded that this list of items should be interchangeable on trailers and their prime movers: wheel bearings, oil seals, brake drum and shoes, shoe springs, and cam bearings.

One speaker thought that trailers should be so designed as to make the condition of the brakes the criterion of other maintenance work. Unlike the tractor, as Mr. Rodgers pointed out, trailers are often serviced and sometimes repaired while loaded.

Only three lubrication points were suggested by Mr. Rodgers. These should be the wheel bearings

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*Symposium "Truck Design from the Operator's Viewpoint" presented at SAE Summer Meeting on June 3, 1946.

1. President, American Trucking Associations, Inc. – "Intercity Service, Eastern States."

2. President, American Transportation Co. – "Intercity Service, Central States."

3. Maintenance engineer. Consolidated Freightways, Inc. – "Intercity Service, Western States."

4. Vice-president; automotive engineer; and superintendent of motor equipment, United Parcel Service of N.Y., Inc. – "Local Trucking Service."

and the fifth wheel plate. Bearings should be repacked only when brakes are relined, he thought.

He said that if the condition of the brake lining should be used as the criterion for other trailer maintenance, he agreed with Mr. Chaddick that a visual examination of the thickness of the lining should be made possible by designing the brake system to permit such an examination.

Standard Floor Heights Needed

Another difficulty faced by truck operators is the lack of uniformity in the height of truck floors from the ground. The American Trucking Association is trying to get a consensus of opinion on the optimum tire sizes of the future. When this is done, Mr. Rodgers said, the motor carriers will look to the automotive industry to standardize the height of truck floors.

The wide variation of loading dock heights is costly in handling freight, and architects, operators, and shippers have been wanting uniformity on the distance from the top of the platform to the street level.

A number of serious accidents have been reported as a result of troubles arising from variance in loading dock heights. The increasing practice of using fork-lift equipment emphasizes the need for standardization on, at most, two truck floor and shipping dock heights, it was pointed out.

Details Loom In Importance

Although the carrier industry is intensely interested in progress reported in the areas of refrigeration and air-conditioning trucks and trailers, and in the plans of the engine designers to produce better powerplants with important increases of output and of longer life, it feels that details such as too thin insulation on wiring systems remain hazards to over the highway transportation.

Marker lights, stop lights, and tail lights have come under severe criticism of the ICC, for example. Several speakers said that this type of equipment should give no trouble during the life of the truck itself.

Many operators find the floor of the truck is of such weak construction that it must be rebuilt several times during the truck's life. Ventilation appears to be uniformly bad, and comfort of the truck driver seldom is considered.

Generally speaking, as one speaker said, trucks are not carefully garaged, but are attacked by the elements day and night – unlike most passenger cars. Thus details of design and construction loom in importance to the operator of inter-city trucks.

CYCLONE 18 PERFORMANCE

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metering, ignition timing, and cumulative minor effects of tolerances and machining differences which usually make apparently identical engines have slightly different power characteristics.

Although the fuel injection engines demonstrated brake specific fuel consumption fractional percentages higher than the carburetion engines with auto-rich mixtures in the high power range, they were found to be more economical in the cruise power auto-lean range by approximately 3 to 4%. Since most long range bombing operation involves long periods of auto-lean cruising and short periods of high power auto-rich operation, it was estimated that a fuel saving of 2 to 3% could be expected by using fuel injection in place of carburetion engines in normal operations.

Metering was more uniform as evidenced by consistently lower spreads between the leanest and the richest engines of the fuel injection airplane. Smoother idling characteristics, better acceleration performance, and complete elimination of any potential induction fire hazard found favor with all pilots. It was decided that the excellent power correlation obtained between the two types of engines warranted a recommendation that power schedules used with carburetion engines in the 20th Air Force be considered directly applicable for use with fuel injection.

Upon completion of the test and data reduction program, a simulated bombing mission was planned and executed with the two airplanes as a final check on accuracy of results. The final test involved a mission of 2890 nautical miles from Guam to a target point outside Tokyo harbor carrying a non-explosive disposable load of slightly over 20,000 lb to be dropped over the target. The two airplanes took off together and returned 14½ hr later after having successfully dropped their "bombs."

In spite of the variables of wind and weather mpg averaged, power required to develop given airspeeds, cowl flap angles required to cool, manifold pressures required to develop given powers, and total fuel consumption were all found to be within 1% of the predicted values for both airplanes. The fuel injection airplane used 2% less fuel for the mission than the carburetion airplane.

The Japanese surrendered before fuel injection engines saw combat in any appreciable numbers. It was a fuel injection airplane that dropped the atomic bombs on Japan on Aug. 6 and Aug. 9.

An indication of the extent to which operational engineering can stretch performance of standard equipment is the non-stop flight of 8158 miles from Guam to Washington, D. C., in a B-29 on Nov. 8 of last year during which mpg charts developed for bombing missions were used. Virtually the same crew broke the official world speed record for cross-country flying by averaging a ground speed of 451.1 mph from Los Angeles to New York.

Car Costs Limit European Design

Mr. Pomeroy's article on European economy cars is timely in view of renewed interest in small passenger cars. He admits that for the attractive mpg rate of the present small car, other important features are sacrificed. But new developments in streamlining, he believes, promise to enhance small car economy sufficiently to compete with larger types.

EXCERPTS FROM PAPER BY **Laurence Pomeroy***

THE type of automobile sold in Europe is bound up with national economics and living standards, and there are certain reasons why these are much lower than those existing in the United States. This fact has two consequences. Firstly, that the total sale of cars is relatively limited, and, secondly, that the weight and size of those models sold is restricted by over-riding considerations of first cost and fuel consumption.

This need for economy has in the past had as its corollary sub-standard performance by United States' valuation but there are certain technical developments which will modify this situation in the future. The maximum safe sustained speeds of small European cars will be increased, and this will not only mean better service for existing owners but result in additional sales to persons who have previously made financial sacrifices to obtain high performance.

Economic Influences on Type of Car

These small types form an overwhelming proportion of the cars sold in Europe and although accurate statistics are not easily obtained from every country the returns for United Kingdom and Germany may be considered typical. In 1938 the growing percentages were:

Under 61 cu in.	*Under 90 cu in.*	*Under 122 cu in.*
United Kingdom – 27.8%	United Kingdom – 71%	United Kingdom – 87%
Germany – 22.8%	Germany – 67.2%	Germany – 81.4%

The group with the largest proportion of sales in both countries was that having 61 to 90 cu in. displacement and accounted for over 4 out of 10 of all cars sold. Very few cars of the size normally accepted in the United States, that is to say of over 180 cu in. capacity, and 50 sq in. piston area, are sold. In the United Kingdom the sales of this group amount to only 7.5% of the total and in Germany to only 4%.

It may be worth analyzing a little further the differences existing between the two types of cars commonly used on each side of the Atlantic.

Again turning to statistics based on the average for number of cars measured and tested, we have

* Paper "The Performance of European Economy Cars," by Laurence Pomeroy, "The Motor" Magazine, London, was presented at SAE Summer Meeting, June 3, 1946.

in respect of physical dimensions, the following for 1938-9:

	Average European Car	*Average United States Car*
Piston area	21 sq in.	62 sq in.
Engine capacity	75 cu in.	225 cu in.
Wheelbase	94 in.	120 in.
Leg room (pedal to leading edge of rear seat)	51 in.	63 in.
Rear cushion width	40.5 in.	46 in.
Weight	2012 lb	3500 lb

Evidently the European buyer accepts a much smaller car (as well as one of lower performance) than the purchaser in the United States. Why should this be? The answer – "lack of purchasing power" – is simple in itself but complex in its implications.

Economics Limit Market

The overwhelming proportion of the European population receives wages which cover little more than the bare cost of food, rent and other unavoidable living expenses. Hence, the quantity of cars owned or produced in Europe is, and will remain, far less than in the United States, and nine out of ten of the minority who can buy have their choice rigidly determined by the need for utmost economy in purchase price and running costs.

On these *a priori* grounds one can set as an ideal that the European car should have a material and man hour content not greater than one-third that of the corresponding American vehicle. In practice, due to the various limitations on output that have been outlined above, the overall man hours per vehicle (including machine tool cost) is greater in Europe than in the United States, and this makes it all the more necessary to reduce to the utmost extent the weight and cost of material employed. It is, thus, not surprising that increasing attention is being given to cars which scale only about one-third the weight of United States vehicles, that is to say about 1000 lb. These are likely to represent the biggest sellers in the future and the 2000 lb car will be the top limit for all except the wealthy few or Government officials.

It has already been shown that the 2000 lb car involves considerable sacrifices in space and the 1000 lb car is, of course, even smaller, offering comfortable accommodation to only two persons with a possibility of carrying children or two adults for short distances.

Accepting these sacrifices in a matter of size let us now turn to another aspect of the automobile, that of performance. Figures for fuel consumption and maximum speed are readily obtainable from the statistics published in the British technical press. These show that the average figures for the most popular type of United Kingdom car with 20 sq in. of piston area compares with the average American product having 63 sq in., in the following manner:

Acceleration Times		*20 sq in. United Kingdom*	*63 sq in. United States*
10-30 mph	High Gear	12.2 sec	7.4 sec
30-50 mph	High Gear	19.1 sec	8.2 sec
0-50 mph	All Gears	23.2 sec	12.0 sec
Standing ¼ mile	All Gears	24.7 sec	21 sec
mpg		27.5	14.5
mph		64	83

There is another aspect of performance which received less attention, but which is of particular importance. This is the matter of cost as affected by durability, which is admittedly hard to assess quantitatively; but some indication may be derived from the indicated horsepower per 100 cu in. of cylinder volume at, say, 60 mph as these factors give a measure of the real work which is being done and an indication of the bearing areas available.

Due to the relatively high speed at which small engines have to be run, the friction horsepower is considerable. For this reason, the relation of friction horsepower to piston speed based on tests made on widely varying types of engine is of particular significance. The mean of these has been taken in arriving at the following table:

At 60 mph	*Drag hp*	*Friction hp*	*Gross hp*	*Gross hp per 100 cu in.*
73 cu in. United Kingdom car	37	12	39	54.5
220 cu in. United States car	35	28	63	29.5

Summarizing, the European car is much smaller than the American counterpart, has an inferior performance, and a much more highly stressed engine. Considerations of material and manpower determine the first named deficiency, and in the next decade at least there is little possibility of a change. In the two other aspects, however, the prospect of great changes has been opened up by the application of brain power in lieu of manpower. It may, indeed, be possible for the small European car to challenge the larger American type in the matters of speed and durability, and, at the same time, maintain or even enhance the lead held in the matter of fuel consumption.

Possible Gains in Small Car Performance

In 1939 a great deal of work was being done in Europe on the genuinely streamlined car – that is to say an automobile with the body shape determined by aerodynamic considerations rather than by style. As a result of wind tunnel tests followed by construction of full scale prototypes, some of which will be discussed later, it was established

hat the drag could readily be halved, in fact reduction in wind resistance by two-thirds was by no means impossible. For this purpose, however, a drag reduction of 50% is being assumed and is a figure comparatively easy to obtain and involving no sacrifice in reduced passenger space or in greatly increased overall length.

The consequences of such a reduction in drag are of particular importance on small cars and show that aerodynamic form is a matter of much greater significance on the European type of car than on the United States type with its initially higher performance. For example, a drag reduction of 50% is equivalent to a theoretical gain in maximum speed of 26%. So using our previously quoted average speed for the European car, this rises from 63 mph to 80 mph, and in the more highly developed type of small car the maximum will rise from 70 mph to 88 mph.

The speed of the aerodynamic European car will in fact be equal to that of the 1939 average American car without changing the engine size or maximum horsepower; but it is important that speed changes within these limits do not involve any serious embarrassment in the weight, chassis design, springing, or brake systems.

This cannot be said for an aerodynamic body as applied to a large car. If we accept an existing 90 mph maximum as a possibility for this type, the top speed with streamline form will increase to 113 mph. Radical changes in the whole of the chassis components will be required in the interests of safety, while tire problems (both wear and rapid rise in tractive loss) become acute.

Perhaps an even greater problem is the inability of the average driver to cope with maximum speeds greatly in excess of 80 mph.

From a practical point of view, the influence of reduced drag on economy is even more important than the gain in maximum speed and can be assessed under two heads, first, fuel consumption and, second, length of life. It is to be admitted that although the small car has overall economy as *raison d'être,* if driven continuously at comparatively high speeds it shows to little advantage compared with larger cars. This can be seen by comparing the conditions of two cars with 75 and 220 cu in. engines both running at a sustained speed of 60 mph. In standard form the results may be tabulated:

	75 cu in.	*220 cu in.*
Engine rpm	4100	3260
Hp Required	27.32	35.2
Mep	72 psi	44 psi
Specific Consumption	0.846 pt per hp-hr	0.82 pt per hp-hr
Mpg	20.7	16.6

If total resistance be halved, the conditions on the smaller car are improved by 65% whereas there is a gain of only 31% for the larger type, thus:

	75 cu in.	*220 cu in.*
Engine rpm	4100	3260
Hp Required	13.66	17.6
Mep	36 psi	22 psi
Specific Consumption	1.025 pt per hp-hr	1.21 pt per hp-hr
Mpg	34	21.7

The effect of drag reduction on the "gross horsepower per 100 cu in." factor is of equal interest. The small car exerted 53 indicated hp per 100 cu in. at 60 mph, whereas the larger engine needed only 23 hp per 100 cu in. – a ratio of 2.3 to 1. By lowering the drag on the small car the indicated horsepower figure falls to 35 or 1.53:1 compared to a large car; so there is a really substantial gain on this head.

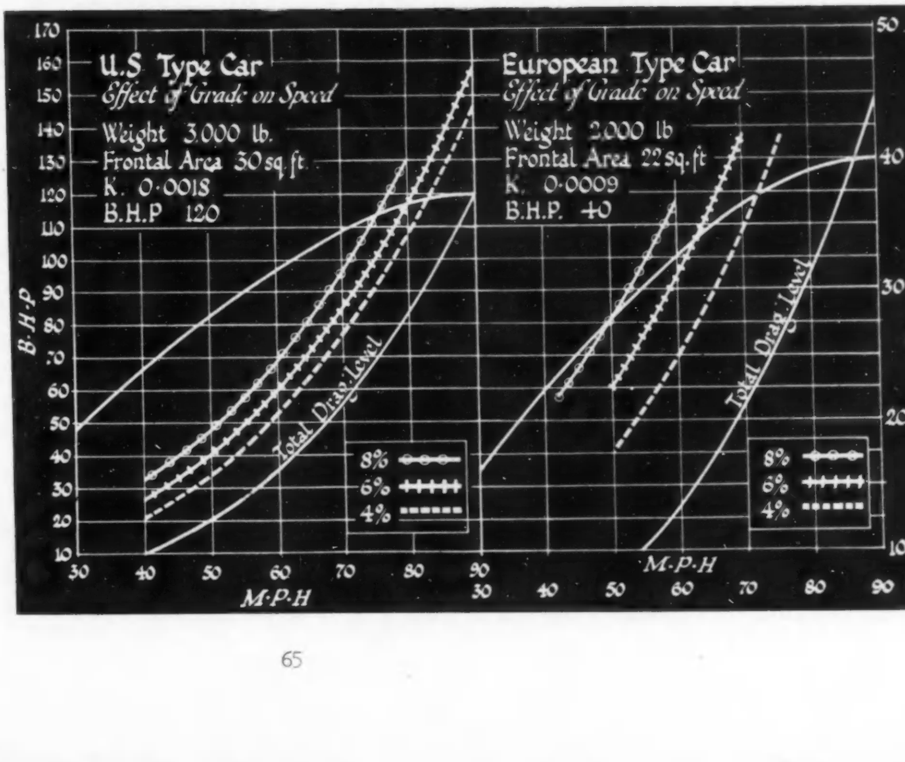
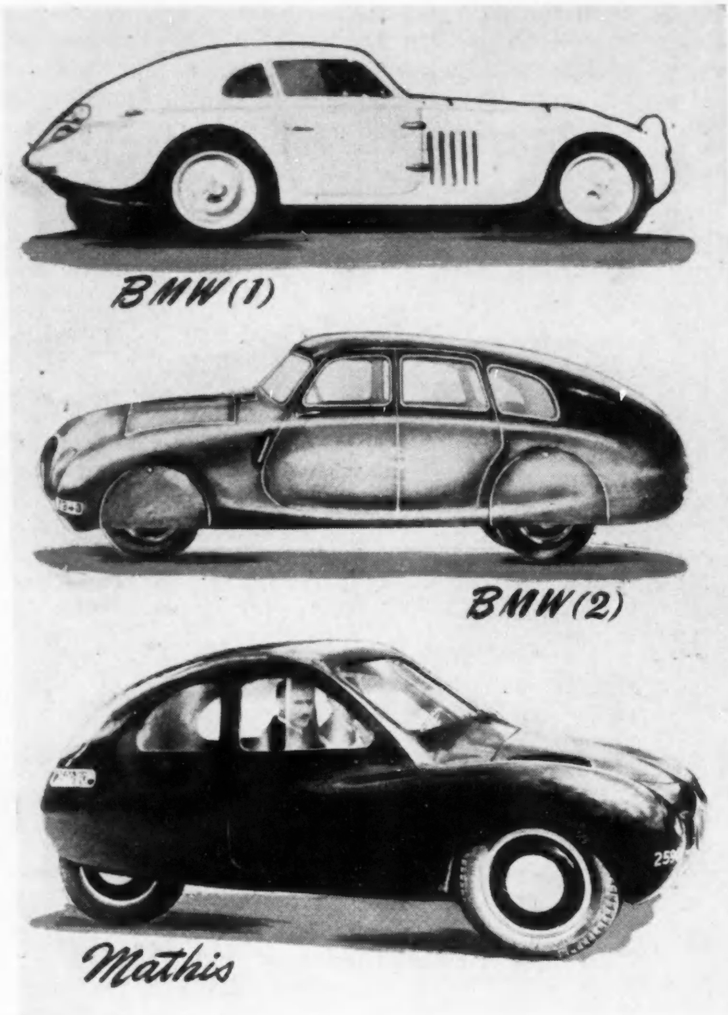


Fig. 1 – Comparison of effect of grade on speed of American and European type cars



"Validity of the information brought forth in this article is checked by these specific examples of some of the more highly developed European cars incorporating aerodynamic form. These admittedly take the form of experimental models; but they are certainly straws which show which way the wind is blowing!"

. . . . . *Laurence Pomeroy.*

BMW (1) Using a gasoline-benzol mixture in its 6-cylinder, 122-cu in. engine, this car can develop a speed in excess of 120 mph at approximately 115 bhp

BMW (2) Also developed at the Research Institute in Stuttgart, this car is interesting as its size is comparable to American models. Its maximum speed of 107 mph indicates about half the drag of its 90-mph American counterpart

MATHIS The 3-wheeled Mathis weighs only 1000 lb and can attain a top speed of 70 mph. Fuel consumption is claimed to be 79 mpg on cross-country running at 41 mph

MERCEDES-BENZ This experimental car was built at the Research Institute in Stuttgart, Germany, and represents a compromise between lowest possible drag and acceptable form and body accommodation

HEALY This newly introduced 4-cylinder British car has 40% less drag than conventional forms. It is a small car by American standards, having a 102-in. wheelbase and 54-in. track

ADLER The Adler is an 1850-lb German car of the streamlined type that is capable of speeds exceeding 100 mph

FIAT In comparative tests this aerodynamic car coasted 3150 ft at 50 mph, or 900 ft more than the standard car

When, however, engine life is under discussion, one is immediately bound to consider the effects of halving drag on top gear ratio. By virtue of the inherent increase in road speed of 26%, the PV factor in an engine with unchanged gear ratio would be doubled. For this reason alone it is imperative to change the relationship of engine to car speed in one way or another. If, as a matter of compromise, the engine speed be reduced by 20%, we can estimate the relative power of consumption figures on a standard 220 cu in. car, a similar car with drag reduced by 50%, and engine speed reduced by 20%, and a 75 cu in. model with the same modifications:

The statement that improved aerodynamic form offers considerable advantages to the small car in respect of top speed, fuel consumption, and engine durability cannot be seriously controverted. The influence on acceleration is more complex.

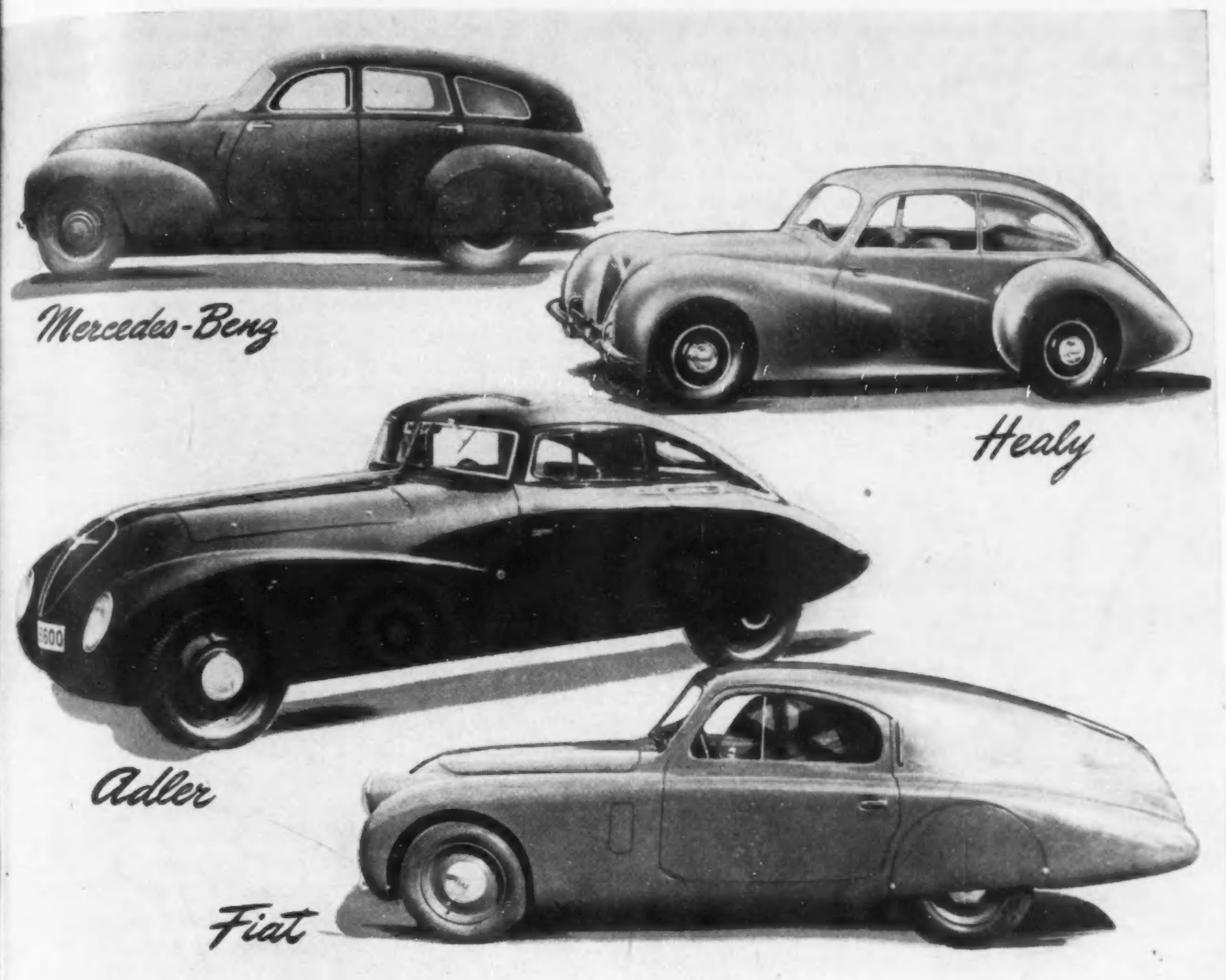
It is obvious that reduction in engine speed will lead to a corresponding lowering of the ton-mile displacement figure with an appropriate diminishing of acceleration rate in the lower ranges of speed, where drag is not an appreciable factor. This defect can be attacked either by the use of an overdrive gear or, more fundamentally, by an effort to reduce weight in the same proportion as the

	Standard 220 cu in.	*Modified 220 cu in.*	*Modified 75 cu in.*
Engine rpm	3260	2610	3280
Hp Required	35.2	17.6	13.66
Mep	44 psi	26.3 psi	45 psi
Specific Consumption	0.82 pt per hp-hr	1.06 pt per hp-hr	0.845 pt per hp-hr
Mpg	16.6	25.8	41.5

It will now be seen that the fuel consumption on the small car has been halved while the required gross power at 60 mph has fallen to 29 indicated hp per 100 cu in.

reduction in engine speed.

It must, however, be admitted that weight reduction to the required degree is difficult for both



commercial and technical reasons. Any considerable increase in first cost will offset the gains in economic running. From a technical point of view one has to consider that in a small car the fixed weights of passengers, fuel, seats, and component parts form a high proportion of the total. Moreover, owing to the greater area of sheet metal needed in aerodynamic cars there is a tendency for the weight to rise. It is, therefore, doubtful if on practical vehicles one can rely on any substantial overall reduction in all-up weights.

For this reason the acceleration of the small car on the upper ratios is bound to be inferior to the large model. Fig. 1 (page 65) shows the calculated speeds up various gradients for two typical cars. All-up weights better than those in common practice today have been assumed in both cases. Even so, it will be noted that despite little difference in the maximum road speeds (87 mph for the small car and 90 mph for the large one) on a 6% gradient the large car will continue at 80 mph, whereas the smaller type drops down to 63 mph.

This disadvantage of the small car may be diminished in the future by developments in roads and with automatic transmissions.

On the modern motor road (as exemplified by the comparatively small mileage now existing in the United States and the many hundreds of miles of autobahnen laid down in Germany) gradients are held down to approximately 4%. This, coupled with freedom from cross traffic, makes both acceleration and hill climbing unimportant factors.

On ordinary roads a fully automatic gear box will give a small car with an aerodynamic body a performance fully equal to that of the normal-bodied large-engined type throughout the operating range. This is shown by some acceleration times obtained on Brooklands Track with a streamlined car having an engine capacity of 67 cu in and developing 42 bhp per ton laden. Using all the four manually controlled gear ratios to the best advantage this car would cover the standing quarter mile in 21 sec, a time identical to that achieved by the average of all American cars tested on the same track under the came conditions.

It is a matter of interest to compare the times taken to reach certain speeds from rest with a specific United States car having 6 cylinders and swept volume of 244 cu in. This model develops 60 hp per ton laden and was fitted with three speed

transmission with overdrive. The times taken were as follows:

	64 cu in Streamline Car	*224 cu in Normal Car*
0-30 mph	5.5 sec	5.5 sec
0-50 mph	13 sec	13 sec
0-60 mph	19.1 sec	19 sec
0-70 mph	31.5 sec	31.5 sec

In sum, if we wish to compare a low drag 75 cu in. car with modified axle ratios with a conventional United States car, we shall get figures of this order:

	75-cu in. Low-Drag Car	*225-cu in. Normal Car*
Maximum speed	87 mph	90 mph
Mpg at 60 mph	41.5	16.6
Road mpg	36	14.5
1 hp per 100 cu in. at 60 mph	29	23
Speed on 6% grade using high gear	63 mph	80 mph
On highest gear 0-50 mph standing ¼ mile	13 sec	13 sec
Using all gears	21 sec	21 sec

Problems with Small Low-Drag Cars

The foregoing evidence proves that the aerodynamic body will exert a profound influence on the performance relationships of large and small cars. It would be unrealistic not to recognize that there are a number of problems which must be solved before this change is realized in the shape of catalogue models having a substantial sale. It will, therefore, clarify the general situation if some of the difficulties are itemized, and some notes made upon their possible solution.

Probably the most important factor in the aerodynamic car is the maintenance of lateral stability. An obvious effect of improved aerodynamic form is to shift the center of wind pressure forward and the more perfect the form the greater this transfer. If the center of oscillation remains unchanged, the car may be inherently unstable in a cross wind and the rate of deviation from the straight – should the car be struck by a sudden squall or emerge from the protection of trees or buildings – may be so high that the driver's reaction induces a lag which makes recovery impossible.

The Forschungsinstitut fur Kraftfahrwesen und Fahrzeugmotoren has made a very close study of this aspect of design under the direction of Professor Kamm.[a] In this a detailed study of the whole problem is made and the solution recommended is the use of stabilizing fins mounted on the tail of the body. This expedient is by no means essential. The form itself can be devised to provide inherent increase in stability with rise in road speed; alternatively, the relations between the center of oscillation and the center of pressure can be rearranged either by getting increased weight forward or by lengthening the wheelbase and placing the main streamline form further back from the front wheel.

Both of these schemes are assisted by employing front-wheel drive which, by replacing the entire transmission weight at front instead of at the back gives a weight distribution of approximately 55/45. Moreover, the dead rear-axle beam (if used) can be cranked so that the rear seats do not have to afford the clearance dictated by the conventional bevel drive on full bump. The elimination of the propeller shaft also permits the lowering of the floor and of the complete car. Thus stability on turns, an important factor on the small car using a sub-standard track of about 50 in., is much improved.

It may be remarked that the advantages in reduced height and floor level are already sufficient to bring the sale of front-drive cars in Europe (excluding the United Kingdom) to one in four of all cars sold and it is probable that the low-drag body will increase the number of cars using this transmission. The stability of the low-drag car is not dependent upon front-wheel drive. The body shapes shown in this article on rear-drive cars give no cause for complaint on this score. There are, however, certain other hidden difficulties with low-drag bodies.

There are two difficulties which are of particular importance in the United Kingdom, of lesser significance on the Continent of Europe – the effect of low-drag bodies on cornering and braking. A stable streamline body will normally give the car pronounced under-steer characteristics. Such a type is difficult to drive in England where there are only short distances of straight roads between corners which can be taken at speeds varying from 30-70 mph, according to the type of car and skill of the driver.

Under-steer not only materially increases the physical labor of driving on such roads but can be positively dangerous. An overestimate of the speed at which a corner can be taken leads to total loss of control, whereas a slight amount of over-steer and rear end break-away, nothing worse than a normal skid will occur.

Cars driven at high average speeds in England also impose severe punishment on braking systems as speeds have constantly to be reduced from say 70 or 80 mph to 40-50 mph at rates of up to ¼ g for normal driving. In this connection, the low-drag car presents problems of cooling the brake drums (which can be overcome by vents and ducts) and in addition provides increased loading on the brake system by the very fact of lower drag.

If one of two cars requires 80 hp and the other 40 hp to sustain them on level road, and if the throttle is then shut and the brakes applied, 40 additional hp has to be extracted from the friction linings to produce the same instantaneous deceleration. For this reason it would seem that, in En-

[a] Paper entitled "Seitenwind und Fahrtrichtungshaltung des Kraftfahrzeugs" by L. Huber in the Sept. 21, 1940 issue of "Zeitschrift des Vereines Deutscher Ingenieure."

and at least, the low-drag car will be forced to use improved and perhaps larger braking system.

Wind noise is a disease affecting all cars since designers abandoned square cut coach work and there is much debate as to whether improved aerodynamic form does by itself provoke greater wind noise. In the absence of much more complete data than are at present available, it can only be stated that some bodies with exceptionally low drag figures are simultaneously remarkably free from wind noise. In fact the noise level at 100 mph can be very much less than is normally achieved on cars with conventional bodies at substantially lower speeds.

Finally, the influence of body form on passenger space and overall dimensions is a matter upon which much confusion has arisen in Europe. The development of the low-drag car has been fostered by long distance races and competition cars designed to succeed in these conditions have been built with closed bodies having long overhung tails. It has been shown by various writers of previous SAE papers that such tails assist – particularly if used in conjunction with carefully formed fore parts – and that drag reductions of 70 or even 80% can be obtained.

The halved total drag postulated for the calculations made in this article can be achieved without exaggerations of this kind and evidence on this matter is presented in the practical examples of low drag cars. Meantime, it is worth noting that by building the sides of the body out to the full width of the wheels, considerable gains in body width are realized so that one may expect the future European car to be able to offer five-seater accommodation, putting three on the front seat and two on the rear seat. It can, therefore, be stated as a dogma that within existing overall dimensions, reduction of drag by one half does not reduce passenger space and may, in certain directions, increase it.

It is hoped that American engineers have been given a general picture of the probable developments in European small car performances in the next decade. Developments in form hold the key to obtaining improved performance in European type cars without encroaching on cost or running charges which have been, and will continue to be, the determining factor in sales.

Economic factors prescribe that normal European cars should not exceed 2000 lb all-up weight, and should be capable of at least 30 mpg in day to day running. Improved body form will permit such cars to sustain road speeds of 70-80 mph. This will make the small economy car increasingly competitive with larger types. This competition will be fortified by world developments in motor roads which will mask the inherent limitations of the small car in the aspects of hill climbing and acceleration.

Which Driver for the Job?

continued from page 27

$13.00 per unit, total premium saved amounted to $15,600. In addition, the program resulted in prevention of an estimated 1800 accidents. Exhaustive studies made by a large insurance company of the *uninsurable costs* of over 1000 accidents, such as lost use of the vehicle, repair cost to the company, time lost in investigation, etc., amounts to $45 per accident, or a saving of $81,000. Cost of the Association's program was $7450 per year, or a return of 800% on the investment.

Is it any wonder then that so many companies, large and small – operators of a thousand trucks or but 10 – consider their driver selecting and training program a valuable investment, and not an expense?

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GERMAN Design MEDIOCRITY

Members of the Technical Industrial Intelligence Committee's automotive team, under the leadership of O. D. Treiber, Hercules Motor Co., visited Germany last year to interview German engineers, inspect remaining plants, pore over captured drawings, and examine enemy equipment.

Highlighted in this article is the behind-the-scenes story of the German automotive industry at work during the war, pieced together by seven members of that team of experts.

Their reports reveal such items as the ingenious overhead valve design and the amazing performance of the "doctored" BMW passenger car engine as well as other unusual engineering feats. But they also emphasize the lack of practical thinking in German design adaptable to mass production methods.

Motorcycles . . .

Digest of Paper

By STEPHAN du PONT

Indian Motocycle Co.

NEW and interesting German motorcycle developments were observed by Mr. du Pont. He reports that the most outstanding advancements of German industry were made in the following:

1. The BMW supercharged racing motorcycle engine,
2. Military motorcycles with sidecar drive, and
3. The DKW double-piston two-stroke supercharged racing engine.

The BMW machine, which "cleaned up" at the Isle of Man International Races in 1939, was powered by an unconventional supercharged, 2-cyl opposed, 4-cycle engine with overhead camshaft. Of special interest is the supercharger design, a Cosette vane type with sliding valves carried in a slotted dural rotor.

This cylindrical rotor is mounted off-center in a cylindrical magnesium housing. The vanes are guided by two free end plates which are completely housed in the magnesium case. The circular groove formed by the hub and rim of the cup-like end plates just fits the vanes and compels them to follow the cylindrical case.

Though there is no friction against the case, the fit is close due to centrifugal force. Only a slight sliding oscillation exists between the vanes and end cups.

The second item, the German military motorcycle, with sidecar drive, was copied from the Belgians. The Germans sorely needed a small vehicle similar to our Jeep. With gasoline and materials getting scarce, the motorcycle was the logical choice. Sidecar wheel-drive could be engaged at will and disconnected on hard roads since there was no differential.

Design specifications prescribed a load capacity of 995 lb including a 3-man crew, a machine gun, and other equipment. Also specified were a 30-mpg fuel consumption and a top speed of 50 mph.

The last development, the novel DKW racing engine, is liquid-cooled and has no crankcase compression. It is a 243-cu cm, 2-stroke supercharged motor. An independent crankshaft oiling system obviates the use of a petroil fuel mixture. This engine also incorporates an unusual feature – differential piston motion – by carrying the exhaust-port power-piston on the master rod and the other piston on the link rod. (Paper entitled "Some Interesting Features of the German Motorcycle Industry's Developments.")

Electrical Equipment

Digest of Paper

By A. J. POOLE

Scintilla Magneto Division, Bendix Aviation Corp.

SLIGHT improvement rather than radical development is Mr. Poole's observation of German progress in electrical equipment during the war. His survey of German industry revealed that:

Scarcity of materials such as beryllium, copper, platinum, mica, chrome, and rubber – that we considered indispensable for many products – compelled the Germans to develop substitutes or do without them. Magneto production suffered from lack of cobalt for magnet steel. Suitable alloys were developed omitting cobalt content when it was no longer available. Copper shortages forced the use of aluminum wire. Even iron segments were employed.

Spark-plug research generated no revolutionary advances. A low-tension plug was under way to overcome difficulties with normal plugs. Its creators hoped it would permit lower voltages, lower fouling tendencies, and necessitate but one heat range. It never went into production.

High-frequency ignition was still an experimental gadget. More complicated and costly than conventional ignition, it offered no advantages from an operating standpoint.

In the realm of magnetos, the flywheel type was almost universal; good design and workmanship was evident. Its ability to produce power for lighting was put to good use.

For products that we manufactured with production machine tools, the Germans used engine lathes and hand screw machines. Their explanation for lack of tooling was abundance of labor – slave labor. (Paper entitled "German Automotive Development of Electrical Equipment.")

Aircooled Engines

Digest of Paper

By A. M. MADLÉ

Briggs and Stratton Corp.

CHARACTERISTIC of the German small engine field since the first war is the dominance of the 2-stroke cycle, reports Mr. Madlé. He points out that:

The Germans claimed the 2-stroke cycle gave a simplified structure resulting in lower cost and higher utilization of displacement. They warned, however, that "both advantages may not be gained simultaneously and full realization of one generally means losing the other one fully or in part."

Major advancement of the 2-stroke cycle in prewar times was the introduction of "loop" scavenging with the flat piston top. This scavenging system increased bmep approximately 15% and improved economy above deflector piston methods by the same amount. "Loop" scavenging also im-

DISCLOSED by Automotive Survey

proves elasticity of the engine considerably above deflector-piston systems.

Both deflector-piston systems and "loop" scavenging are variations of contour scavenging, in which the intake and exhaust ports are on the same side of the cylinder and the flow of scavenging air follows the cylinder contour.

Several attempts were made to improve scavenging by breaking up the eddies. One manufacturer removed the boundary layer which gives rise to eddies by means of small auxiliary ports connecting into the exhaust manifold. Scavenging was claimed to be improved to the point where supercharging could often be dispensed with. Another method of preventing eddy currents was to blow them off by means of special jets arranged at the turning point, right below the transfer point. This was considered an important advance.

Attempts to further increase engine elasticity led to dynamic charging using an asymmetrically timed valve. This feature was incorporated in two Triumph engines.

Envisioned as the trend in the German postwar engine industry (if it had ever come into being) based on several special war applications observed are these three classes of engines:

1. Smallest constant speed applications – cross-flow scavenging with deflector piston;

2. Larger engines with higher compression ratio operating under more varied demand – either "loop" scavenging or cross flow with the flat-top piston;

3. Engines meeting extreme demands on power, economy, and elasticity – dual-piston uniflow system with asymmetric intake valve and optional asymmetry of port timing.

(Paper entitled "German Automotive Development – Aircooled Engines.")

Injection Equipment

Digest of Paper

By R. C. MATHEWSON

American Bosch Co.

THE search in Germany for simple inexpensive fuel injection equipment was a complete failure, admits Mr. Mathewson, although he did find a number of interesting items. He discovered that:

No striking developments were made in diesel injection equipment although the Germans were ahead of us in gasoline injection pumps. Most of their talent and energy was directed to development of jet engine equipment near the end of the war.

Fuel systems used on jet engines were the common rail type with two or more rotary-type displacement pumps to deliver fuel to the 6 or more spray nozzles or burner tips. To ensure more even distribution to individual combustion chambers, Bosch (of Germany) developed a cam-operated piston pump running at 5000 rpm with 12 cyl connected in pairs to common volume chambers.

Each of the 6 common volume chambers was connected to a nozzle ⅝ in. in diameter and ⅝ in. long – a recommended goal for future fuel injection equipment. The nozzle had a mushroom-headed spring-loaded valve with a small hole through the center. At idling loads this hole was sufficient to take care of fuel being pumped; but with increased fuel flow, the valve opened. Atomizing at all quantities was good and the pump ran quieter than would be expected.

For the BMW airplane engine they developed a 14-cyl barrel-type gasoline injection pump. It had a 3-lobed disc cam rotating at 1/6 engine speed. General design appeared good although trouble was experienced with uneven distribution to the cylinders at high altitudes.

Another interesting development was a truck engine governor using bypass fuel from the fuel pump as the governing medium. Instead of returning to the piston side of the pump, the bypass fuel acted on a spring-loaded piston that had a leak-off orifice in it.

German engineering during the war is characterized by these impressions:

1. Germans in some respects were more conservative in their designs than we were;

2. They hadn't lost their love for gadgets;

3. They demonstrated that even in these days of precision tools, a skilled craftsman is still needed to diagnose equipment performance and to correct faulty parts. (Paper entitled "German Automotive Developments – Diesel Engines and Injection Equipment.")

Transmissions

Digest of Paper

By E. F. NORELIUS

Allis-Chalmers Mfg. Co.

LACK of simple thinking led to overdesign, notes Mr. Norelius, with the result that German designs were not founded on high production methods as we know them. Highlights in the maze of complicated automotive devices, he observes, are:

1. Design of discs for multiple-plate wet clutches;

2. The electro-magnetic shift transmission;

3. The Voith hydraulic torque converter;

4. Hydro-static steering.

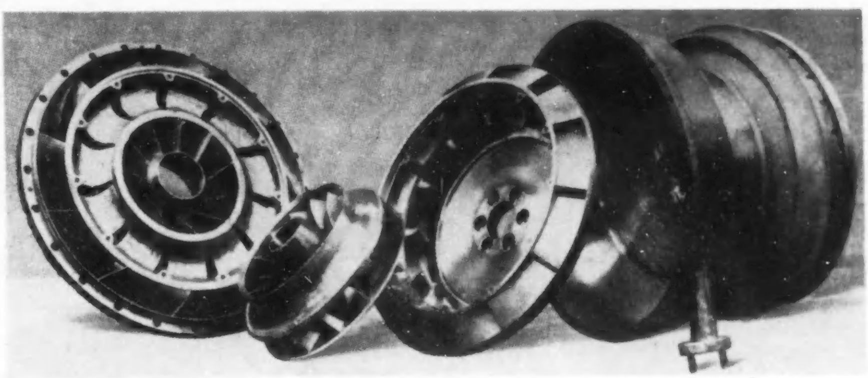


Fig. 1 – Parts of the Voith torque converter. Cast-iron castings and hand-ground vanes are items of interest in this design. Aluminum alloy castings were used in higher speed units.

A great deal of effort was exerted in cutting out clutch plates to avoid warpage. Plate separation on multiple disc clutches was accomplished in several ways – one being to purposely warp the plate to produce separation. Positive separation was achieved by bent tangs on the outer circumference of the plate pressing against the adjacent plate.

Electro-magnetic clutch shift transmissions were designed in several sizes with 6 and 12-speed units, some of which were built. None went into production, the principal problem in this type of clutch being development of a material without residual magnetism properties.

The Germans endeavored to use torque converters in war equipment, though no evidence was found of any in use – except in an experimental way. Fig. 1 shows parts of a torque converter made by Voith. It is interesting to note that the castings are made of cast iron and the vane faces were finished by hand grinding. For higher speed units, the pump and turbine wheel were aluminum castings.

The fourth item, hydro-static steering, was under development but not ready for production. In one type the pump was constantly driven and provided oil for the hydraulic motor, geared to drive the sun pinion of the epicycle. Gearing was arranged so that sun pinions on opposite sides of the vehicle were driven in opposite directions. (Paper entitled "Automotive Power Trains, Clutches, Transmissions, and Steering Mechanisms.")

Chassis

Digest of Paper

By A. M. WOLF

Automotive Consultant

THAT he found no new developments in German non-military car and truck chassis is understandable to Mr. Wolf since few new cars were built during the war. In a résumé of German design practice he showed that:

Low production as exemplified by a maximum output of 500 to 600 trucks per month of the largest German manufacturer permitted designs that could not be tolerated in mass production. The spaghetti-like central chassis lubrication used in almost every truck and bus would have greatly slowed up our production lines.

Just before the war Opel built several experimental cars with a wishbone front-end and a rigid rear axle with diagonal forwardly extending torque arms joined and centrally anchored to the frame with a ball joint. This design gave improved riding qualities, better steering control, and relieved the frame of many usually encountered stresses.

Since the suspension system often replaces the rigid axle, the word "axle" in German terminology embraces the entire suspension and axle members. Swinging axles are very popular and caused considerable anxiety among American personnel when the wheels became "bow-legged" – especially when jacking up the car.

Mechanical brakes are still used on small cars and trucks. Servo-action is generally incorporated for equally effective braking in forward and reverse movement. Air brakes predominate the commercial field due to popularity of 4-wheel trailers. Some trucks have a hydraulic system with a compressed air booster system.

Overall design showed lack of standardization. An SAE type of organization is sorely needed by the German industry. (Paper entitled "Chassis Developments in the German Automotive Industry.")

Gasoline Engines

Digest of Paper

By A. W. POPE, JR.

Waukesha Motor Co.

DESPITE the monotonous similarity of German and American engines under 100 hp, superlative German craftsmanship and detail refinement are worthy of note, says Mr. Pope. He points out that:

An example is the 6-cyl, 120-cu in. BMW sports model engine. A refinement of their standard passenger car engine, it is designed along conventional American lines with push-rod operated overhead valves. By doctoring up the engine and using a sports model body, it established a remarkable race record of 119 mph on the 100-mile lap at Brescia, Italy, and a straight away record of 158 mph. Accomplishing this with an unsupercharged, push-rod operated, 2-valve engine is a tribute to German skill for detail refinement.

Probably the most interesting trend in German engine design was shown by several engines with overhead valves mounted across the engine axis. There were two reasons for this arrangement. In the aforementioned BMW engine it made room for a larger valve for the high speed output. In other cases it was done to develop aircooled engines with cross-flowing cooling air. Mounting the valves across the engine axis provided space for cooling air flow between cylinder heads.

Valve Arrangement Unusual

Push-rod operated valves were favored over the overhead camshaft. They are relatively simple when the valves are laid on the engine axis, but require considerable ingenuity to reach the valve located on the side opposite the camshaft. The Germans worked this out in several interesting ways.

Most difficult case is the BMW sports model engine type inclined valves. In this case the valve on the far side is operated by an auxiliary horizontal push-rod and rocker arm reaching across the engine. In a simpler design developed for 8-cylinder and 10-cylinder engines the far valve was reached by inclining the push-rod and bringing it up between the cylinders. (Paper entitled "Summary Report on German Automotive Gasoline Engines.")

Recent CAA Rulings Insure Safer Flying

Digest of paper

By R. C. LOOMIS

Transcontinental & Western Air, Inc.

EXPANDING airports and new planes must comply with the so-called "T" Category requirements of Civil Air Regulations Section 04. Enacted for transport planes, these special requisites are highly desirable from a safety standpoint and put aircraft performance on a more logical basis, says Mr. Loomis. But they place an added burden on aircraft manufacturers and operators. He reports that:

These regulations require certain minimum rates of climb in take-off, enroute, approach, and landing. They further require that a take-off path be constructed based on demonstrated performance of an airplane. Usable landing distance is also based on aircraft performance.

To meet these requirements the manufacturer must make a more complete demonstration of the airplane's performance and the operator must more thoroughly survey all the airports in his system, applying manufacturer's performance data.

Now airport and airplane will be tailored to suit each other. Formerly both plane performance requirements and runway landing characteristics were established irrespective of each other with obvious consequences. (Paper "Application of 'T' Category Licensing Test Information to Airline Operation," presented at SAE Kansas City Section, June 4, 1945.)

AIR TERMINAL DESIGN

Can Make or Break Carriers

Digest of paper

By A. F. HEINO

United Air Lines, Inc.

UNWISE spending of millions of dollars and a breakdown in aircraft handling face the air transport industry unless terminal procedure and design undergo radical change, warns Mr. Heino. He points out that:

Today passengers must enter and leave the airplane at a distance from the terminal, sometimes exposed to inclement weather before reaching cover. Trucks carrying mail, gasoline, commissary goods, and express cluster about the plane like chicks about a hen. Passengers will not put up with this inconvenience much longer; disorderly servicing and handling bottlenecking current operations darken the picture of expanding business.

Plan for Efficiency

For large airports such as New York and Boston, unit terminals offer a solution to the problem. People and cargo can be handled more efficiently and more quickly in small groups than from one point. Such plan retains the identity of each carrier and permits him to control his own operations. Operating facilities common to all airlines could be housed in a central terminal.

Basic objective should be a terminal unit fitted to the airplane itself, permitting passenger and cargo movement in and out of the plane while it is being serviced. This calls for a fixed dock and nosing-in (or tailing-in) of the aircraft such as the design shown in Fig. 1.

In large terminals this arrangement would save considerable apron length for a given number of planes. Such positioning also will permit a narrower apron.

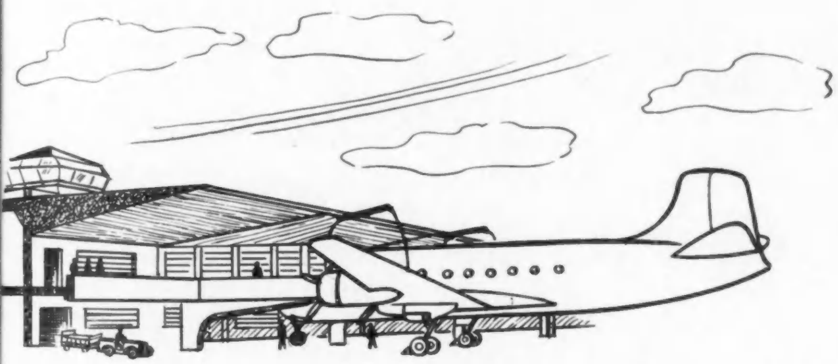


Fig. 1 – This type of terminal dock speeds up airline ground operation and increases efficiency by separating passenger handling from operational services

To make nose-in docks practical, the aero engineer must assist by designing aircraft to provide sufficient propeller clearance. Airplanes may approach such docks under their own power as slip stream effect will be negligible.

To secure maximum flexibility, laterally moving docks can be constructed to accommodate various aircraft sizes. At such docks it is possible to have overhead refueling – the dream of all maintenance men. Unsatisfactory methods of under-apron servicing can be eliminated entirely.

Passengers can be loaded under cover of the terminal at the upper level while cargo and mail handling and airplane servicing is carried on exclusively at the field level. This would separate completely passenger service and operational functions, achieving a major objective – the saving of time.

Another approach to dock design is the underground concourse, shown in Fig. 2. In this plan access is provided by an underground tunnel with entrances at each plane position. All services necessary for the plane will be built into tunnels also serving as passenger thoroughfares. Capital and maintenance costs render such plan impractical.

Terminal building design should be expressive of the air transportation function it serves. It should assist in increasing the industry's greatest asset – speed. (Paper "Airport Terminal Design," presented at SAE Air Transport Engineering Meeting, Dec. 3, 1945.)

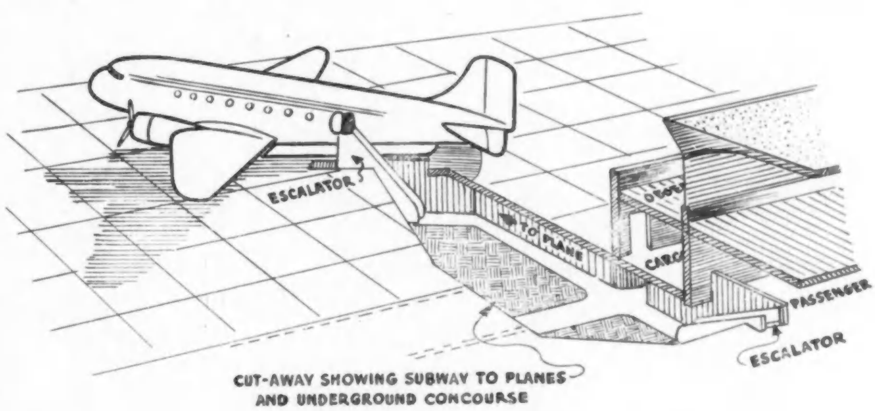


Fig. 2 – To provide customer convenience and comfort and relieve the ground handling problem, airlines can "go under". A network of tunnels leading to plane positions would do the job, but its cost is prohibitive

German "Viper"

JETS ROCKETS TURBINES

Germans Paced Field In Supersonic Flight

Digest of paper

By R. A. COLE
Wright Aeronautical Corp.

THE Germans were probably ahead of us in practical application of high-speed propulsion and we can profit by what they learned so that no one can surpass us in the new domain of supersonic flight, says Mr. Cole. His survey in Germany of rocket propulsion developments disclosed that:

First of the practical rocket-powered planes, the Me 163, was developed to attain a calculated speed of 620 mph and operate at altitudes of 50,000 ft. Time to reach 40,000 ft was just over 3 min.

What makes this such a remarkable plane is its powerplant – a bi-fuel, liquid rocket motor mounted in the tail. One propellant, known as "C-Stoff," consisted of hydrazine hydrate, methyl alcohol, water, and a catalyst. Hydrogen peroxide is the other fuel and is called "T-Stoff." Catalytic action decomposes the peroxide to form steam and oxygen at 900F. The mixture provides pumping power for both propellants and drives the turbine.

Propellant consumption is a little over 20 lb per hr per lb or a specific impulse of 175 lb per lb per sec. Fig. 1 shows the rocket motor installed in the Me 163.

Though much simpler than that of a conventional plane, the control system complicated the relatively simple rocket unit. All the Me 163 cockpit had was a power control lever, a starting switch, a tachometer, and a temperature indicator for fire-warning. For the propellant system there was a tank gage for peroxide, a low-level warning light, and a dump valve.

Fig. 1 – Rocket powerplant of the German Me 163 interceptor enabled the plane to fly at speeds approaching 600 mph and climb to an altitude of 40,000 ft in just over 3 min

There was no powerplant lubrication system except for the accessory gear compartment. Rocket motor control was simple because much of it had to be automatic instead of being left to the pilot's care. It provided almost infinite variation from low to maximum thrust. At the same time the mixture was kept constant, guarding against dangers of excessive pump speed and pressure, failure of a propellant, and accumulation of explosive quantities of propellant in the system.

This same powerplant was used in the "Natter" or "Viper," a good example of the German designer's flair for the fantastic. The plane, shown above, was launched vertically by a cylindrical tube to a height of 500 ft where an automatic pilot took over to fly a predetermined course. The human pilot merely sat back and watched for attacking bombers.

Upon sighting them, he took over from the automatic pilot, and attacked by firing all 24 rocket projectiles in the nose of the plane. He then dove and settled back to 150 mph, releasing the nose, aerodynamic forces pulling it forward. Next step consisted of releasing a rear parachute that slowed the plane suddenly; the pilot kept moving forward. He simply pulled his own ripcord at the proper moment and floated safely to the ground – so the Germans hoped. Death of the pilot in a crack-up of the first flight test put a damper on this project.

Many other rocket plane models were well beyond the drawing board stage on V-E Day. Who knows what a six month delay would have meant? (Paper entitled "German Rocket Aircraft and Their Powerplants" presented at the SAE Metropolitan Section, March 7, 1946.)

...n New Era in Power

...hors Show How and Where ...vers Are Being Harnessed

Flying Jets, Rockets Create New Concepts

Digest of papers

By LOVELL LAWRENCE, JR.
Reaction Motors, Inc.

and J. F. MANILDI
G. M. Giannini & Co.

GREATEST departure from conventional propulsion since invention of the airplane is the recent advance of jet and rocket engines into the age of flight, agree both Mr. Lawrence and Mr. Manildi. It has revolutionized aeronautic thinking and opened new horizons to man's race against time. Included among the many pertinent ideas about these new types of powerplants revealed in these two papers are the following:

Rockets and the three kinds of jets – turbo, pulse, and ram – have been developed to the point where each lends itself to a particular type of flying operation.

In the speed area of 500 mph to approximately the speed of sound the turbo-jet will take over from the conventional propeller engine. Most important advantage of the turbo-jet over the piston engine is its ability to handle a great deal more energy per unit time, producing much more thrust per unit weight.

Simpler Machine

Another advantage of the turbo-jet is that propulsive power is applied directly; no complicated mechanisms are required for converting linear to rotary motion and fewer accessory parts are needed to maintain operation.

The pulse-jet appears to lend itself to subsonic speeds and potentionally to transonic and supersonic speeds. An example is the infamous German V-1 buzz-bomb. At present the pulse-jet is most useful to the military.

Application of the third jet type, the ram-jet, is narrowed down to supersonic flight in an atmospheric medium since the size of the ram per unit thrust at subsonic speeds would be prohibitive. It has not been successful as a primary aircraft powerplant but will serve as a useful tool in exploring the realm of supersonic flight.

Just a Fourth of July toy a few years ago, the rocket today can be applied as an aircraft powerplant in three ways. The tremendous amount of energy it develops with a minimum of weight and fuel for short periods makes the rocket useful in assisting take-off and climb. Secondly, it can be used as a main powerplant as in the German Me 163, below. In this case it is used in combination with an aircraft that becomes a glider when the propellant is consumed.

Lastly, rockets may be used as powerplants for projectiles and flying laboratories where ultra supersonic speeds are required. The German V-2 long range missile is an example.

With so much newsprint devoted to what pundits of science and the military are saying about these engines of the future, a description of them is in order.

Jet motors have one fundamental feature in common – the mechanism by which thrust is produced. All jet engines take air from the atmosphere; add heat by some device, then expell the air rearward at a velocity greater than that of the air being taken into the motor, producing forward motion.

Operation of the turbo-jet in its simplest form is shown in Fig. 1. Air is taken in at the left, compressed by an axial flow or centrifugal compressor, and enters the combustion chamber. Part of the air is used to burn the fuel injected into the chamber where heating of the total air mass takes place at nearly constant pressure. Heated air passes through the turbine, undergoing a drop in temperature and pressure.

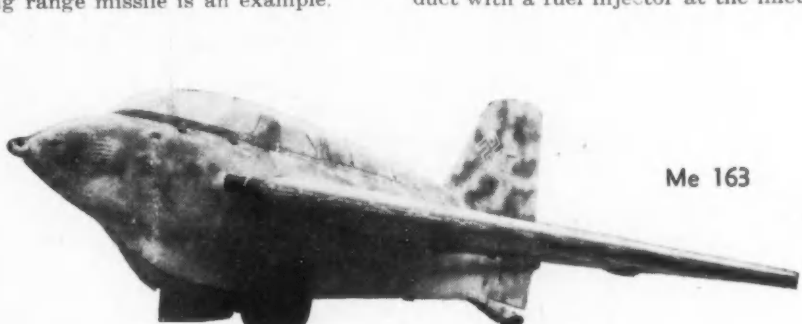
Mechanically coupled to the compressor, the turbine furnishes power to drive the compressor. Still under pressure and at elevated temperature, the air then passes through the exhaust nozzle and imparts forward thrust to the unit.

Turbo-jet performance is characterized by a roughly constant thrust with varying air speeds – as opposed to the approximately constant horsepower characteristic with air speed of a propeller. Due to decreased air density, the thrust drops as the altitude increases.

An even simpler engine is the pulse-jet, shown in Fig. 2. It consists of a combustion chamber; a set of valves to permit flow from left to right and check any tendency for reverse flow; a fuel injection nozzle forward of the valves; a spark plug; and a tail through which the jet exhausts. Thin metal sheets on a metal seat make up the valve; it acts under forced vibration in roughly the same fashion as a vibrating reed.

Phenomena in the pulse-jet is an intermittant explosion rather than steady burning.

Like the pulse-jet, the ram-jet is also an air stream engine. Main difference is that the ram-jet must operate at comparatively high speeds if it is to function at all. It consists of a straight duct with a fuel injector at the inlet.



Me 163

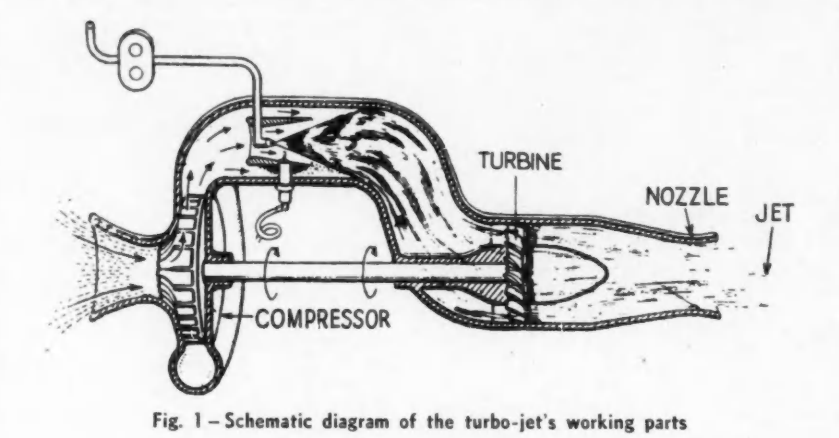


Fig. 1 – Schematic diagram of the turbo-jet's working parts

Let us picture a perfect cylinder of some length. At a condition of no combustion, air at both the cylinder inlet and outlet is almost at the same velocity as the air through which the tube is travelling. Heat reduces density of the exit gases and increases velocity above that of the ambient air. The jet then produces thrust in a manner similar to the squeezing of a grape.

Rockets and jets are fellow-travelers, but not members of the same family. The rocket does not rely on atmospheric oxygen; it carries its own oxidizer in the form of a propellant. It employs the regenerative principle wherein one of the propellants flows at high velocity along the walls of the nozzle and combustion chamber. Some of the heat of combustion transfers through the chamber wall and is picked up by the high velocity liquid.

Transfer of the heat through the liquid cools the chamber wall and returns back to the combustion chamber the dissipated heat energy. The other propellant is then injected directly into the chamber where the two are thoroughly mixed. Some of the propellants are spontaneous; others such as liquid oxygen and alcohol must be ignited.

Rocket engine efficiency is measured by the number of pounds of thrust developed for every pound of propellant consumed per second. Velocities as high as 7000 fps have already been attained.

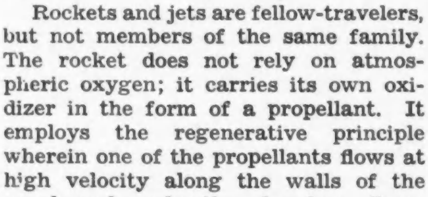


Fig. 2 – The pulse-jet is a subsonic propulsive unit that at present is applicable to the field of guided missiles

Fuel consumption at this jet speed would be about 0.0044 lb per sec per lb of thrust. At such high rates of consumption the rocket engine must travel at speeds of 3000 mph to compete with the conventional reciprocating engine in fuel consumption.

The fund of design knowledge being gathered in high-speed tests of these Buck Rogers devices points to the possibility of long-range supersonic aircraft between places such as London and New York. Long-range high-speed flight will be quite comfortable provided maximum accelerations of 1 or 2 *g* are maintained only for short periods. At speeds of 2500 mph it is possible to get the same mileage per pound of fuel as at 350 mph. (Lawrence paper entitled "Pulse Jets, Ram Jets, and Rockets," presented at the SAE Metropolitan Section on June 13. Manildi paper entitled "The Theory of Operation and Fields of Application of the Turbo-Jet, Ram-Jet, and the Pulse-Jet," presented at the SAE So. Calif. Section, April 19, 1946.)

Gas Turbine Competes In Ground Power Field

Digest of paper

By J. R. CARLSON

Westinghouse Electric Corp.

IS all the time and effort expended by engineers in developing the power industry's "pin-up girl" – the gas turbine – justified? Mr. Carlson believes that it is and supports his point by showing that:

The glamourous gas turbine can compete with almost every type of powerplant – both stationary and moving.

In the central station industry the steam turbine is the most advanced method of producing power. With the addition of heat-reclaiming apparatus and compressor intercooler combined with one stage of reheat, the gas turbine will compete thermally with the steam cycle. But since gas turbine parts are large and the materials costly, costs must be reduced without impairing thermal efficiency.

This can be done in two ways. One is to operate the turbine and compressor at very high speeds. By this method dimensions can be shrunk and the weight of needed expensive alloys reduced.

Boosting Pressure

Second method of reducing size of parts is accomplished by initially pressure charging a closed system. In one such system developed in Switzerland, instead of compressing the air from 15 to 150 psi, the system is initially charged with air at 90 psi. Working with the same pressure ratio, the compressor discharge pressure will then be 900 psi. Size of turbine parts will be reduced in the ratio of absolute pressures or to 1/6 of their original size.

An economic study conducted by Westinghouse to evaluate this system disclosed that the size and cost of the turbine and compressor are entirely reasonable and practicable. Since thermal efficiency of a steam station is 34 to 35% regardless of cost, it is comforting to know that when increased fuel costs dictate more efficient power stations, the gas turbine offers an out.

Combining a diesel engine, compressor, and gas turbine gives a power generating unit for merchant vessels that shows great promise. Thermal efficiency obtained from this arrangement is in excess of 40%. Its weight is low and the cost should be attractive. This prime mover will be of interest to the Navy as well as the central station industry.

Railroad Application

For railroads using liquid fuel as a source of power, the gas turbine offers a means of building compact and high power locomotives. Two gas turbine sets could easily be located in a locomotive cab with room to spare. Absence of cooling water, smooth and high starting torque combined with high power and increased efficiency are distinct advantages.

In the sky gas turbine propeller drives of 5000 or even 10,000 hp will soon be propelling giant airliners of the future. Progress being made in this field is well known.

Future of the aircraft gas turbine is indeed bright. Next important application is in railway service. Rapid funnelling of aircraft experience into railway application will make possible 10,000 hp locomotives hauling crack passenger trains and high-speed freight trains. (Paper entitled "The Gas Turbine in Industry" presented at the SAE Washington Section, March 14, 1946.)

Accent Simplicity and Economy In Personal Plane Design

Private flying may be on the threshold of unlimited growth if Mr. and Mrs. America are given the needed facilities to sprout their wings. This growth can be accelerated, say these SAE authors, if both the aviation industry and Government fulfill their obligations to the prospective flyer.

They report that the personal airplane must satisfy several vital "musts" before it becomes widely accepted. First it must be made safe and easy to fly. Cost of the plane and its operation must be kept to a minimum, within the income range of as many people as possible. Equally as important as the airplane itself to the future of private flying, they point out, is a wide network of easily accessible airports.

How these fundamental prerequisites of flying for the masses can be achieved is outlined in these articles.

Ground Facilities Needed

Digest of paper

By J. H. GEISSE

Civil Aeronautics Administration

JUST as the automobile was dependent upon streets and highways for its growth, so the airplane is dependent upon availability of airports for its development, says Mr. Geisse. He shows that:

In a survey of those who discontinued personal flying, it was found that airport inaccessibility ranked second only to cost in the reasons for discontinuance. Some progress is now being made to correct this situation, but the picture is not too bright.

Lack of funds is hampering the CAA in supplying advice and counsel requested by municipalities. The Federal airport bills passed by Congress last year are still tied up in conferences between the Senate and House.

But these are not the only headaches. "Public-spirited" citizens are placing the same obstacles in the path of personal flying development that they placed in the path of railroad and automobile development. In one case not one of the 20 airports proposed in a city could be constructed due to neighbors' objections. Airports must go somewhere and there will always be neighbors. They must be conveniently located or they will not serve their purpose.

A private airport should be no more objectionable than a filling station; its convenience will be found just as important to those presently objecting as is the filling station.

Another project of great importance is that of developing a roadable airplane. Were such airplane available now it would answer a most serious airport problem for owners. The need for close fields would not be so great if you could drive to the field in the airplane. Taxi fare to and from airports would cease to be a factor in flying costs.

In addition to easing the airport accessibility problem, the roadable airplane solves the serious weather interruption problem. An owner cannot afford to start out in his airplane to keep an appointment if there is any possibility of the weather closing in. But if he could land and continue his trip by highway, all he would have to allow for would be the possible difference between ground time and air time for part of the trip.

Lack of hangar space constitutes still another handicap to the growth of personal flying. This condition is slated to remain critical for some time due to the scarcity of building materials and the likelihood that they will be allocated to other types of construction.

But even this problem can be eased if manufacturers would build planes with folding wings. The English have been using them for years to save hangar space. Increased cost and weight accompanying this change would be small. Such development will be forced sooner or later by limitations of parking space in downtown parking areas – about which much is being said.

One bright spot in the picture is the probability that pilots will be offered a national cross-country rental service, from which they can rent an airplane in one city and turn it in at another. This will be the biggest step forward since the inception of personal flying. It will convert flying from a sport to a utility.

Owning a private plane is at best fairly expensive. Renting an airplane just to fly around the airport is still a fairly expensive sport in both time and money. In contrast, renting an airplane to make a trip that otherwise would have to be made by some other means of transportation should not be costly in time nor money. There would probably be a saving in time and the cost should not exceed that of rail plus pullman. With high utilization of equipment attainable in such service, rental charge should not exceed 10c per mile for a 2-passenger plane with a cruising speed of over 100 mph. Such service will provide fast, economical, and convenient transportation within the means of many.

We are now entering a new age and we had all best take cognizance of this fact. It is within our capabilities to eliminate the present stumbling blocks to personal flying. By doing so it will become an important factor in our social economy – available to many and not just a few. (Paper entitled "Personal Flying for the Many" presented at the SAE Baltimore Section, Feb. 14, 1946.)

Cheaper Engine on Way

Digest of paper

By J. W. OEHRLI and V. J. JANDASEK

McCulloch Aviation, Inc

GROWING demand for better performing personal aircraft at lower initial and operating cost has attracted attention to new engine types. Answer to this search may lie in the opposed-piston 2-cycle engine, say Messrs. Oehrli and Jandasek. Based on preliminary studies of a single cylinder engine of this type, they show that:

Improved weight ratio with good fuel economy and low manufacturing cost can be had in the 2-cycle engine.

General arrangement of this engine is shown in Fig. 1. Each cylinder contains 2 opposed pistons connected to 2 separate crankshafts at each side of the engine. Power is transmitted from pinions on the front ends of the crankshafts to the larger propeller shaft gear between them. The combustion chamber is the cylindrical space between the pistons at the center of the cylinder.

One piston controls the inlet port and the other the exhaust ports, providing a uniflow arrangement. The exhaust crank is given a lead to the position shown in Fig. 1 so that the exhaust ports are well open to blow down the burned charge to a low pressure before the inlet piston permits entry of the fresh charge. A gear-driven super-

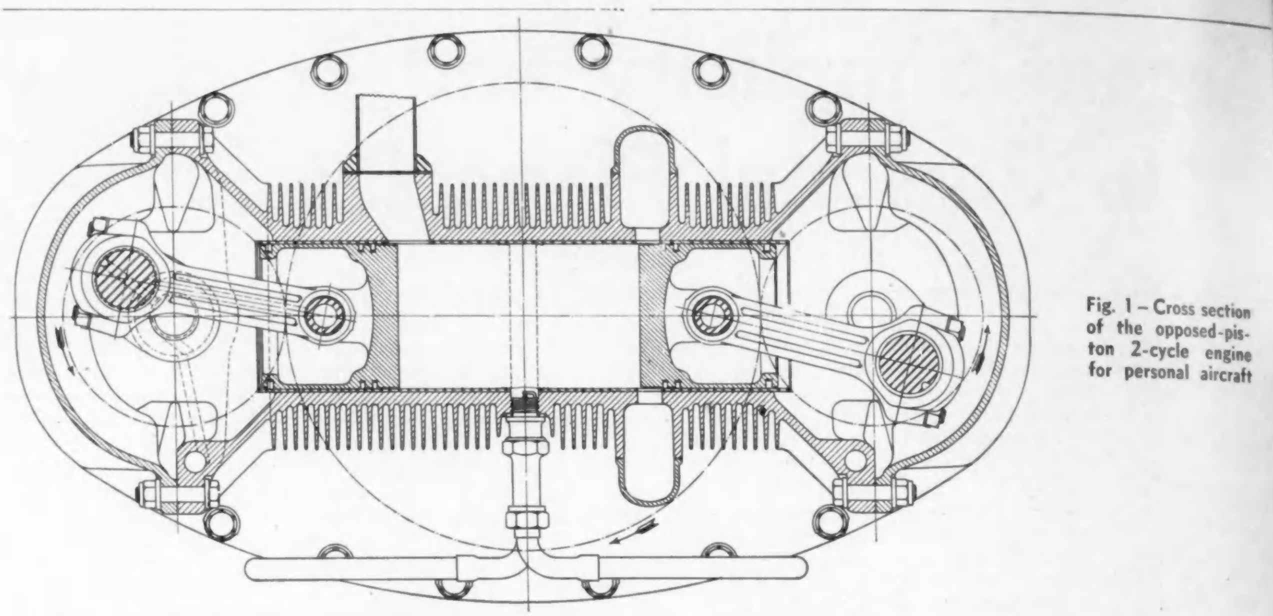


Fig. 1 – Cross section of the opposed-piston 2-cycle engine for personal aircraft

charger forces the new charge through the inlet ports to provide rotation about the cylinder axis which, it is believed, aids stratification or separation of the fresh charge from products of the previous combustion.

A fuel injector discharges the fuel into the inlet manifold through individual nozzles for each cylinder.

Shown in Fig. 2 is a mock-up of the multicylinder engine.

Performance of a 3-cyl engine predicated on single cyl tests is shown in Fig. 3, allowances having been made for distribution and other minor discrepancies usually encountered in multi-cylinder units. It is interesting to note that pumping losses of a supercharged 2-cycle engine of this type are about ½ those obtained in a 4-cycle normally-aspirated engine of comparable size. This raises overall mechanical efficiency to a very desirable figure.

Fuel economy for this engine places it on par with the best engines now available for this service.

In designing this engine several factors may be exploited to obtain a light, compact, and efficient powerplant. Moderate stresses and simple design of all parts permit economical manufacturing and servicing. Lower bmep together with small displacement reduces mean and maximum forces of all parts from piston to propeller. Practically no reversal of load on the connecting rod further reduces fatigue stresses.

These conditions permit smaller parts and reduce maximum bearing loads to ½ the usual values.

Construction of the multi-cylinder engine is unique. The main engine structure, the integral cylinder block, is an aluminum casting. It requires no complicated external cores and is easily inspected and cleaned. Thin liners are shrunk in place and honing is simplified by the open bore at both ends.

The cylinder block is designed for high production machining and is as distinct an advance in cost reduction as was unit block construction in the automotive industry. Cylinder-head attaching screws or threads and joints in the combustion chamber are completely eliminated.

All other castings are made in 2-piece molds with no cores and are well-adapted to permanent mold or die casting.

All screws are easily accessible and, except for the spark plugs, only one wrench is needed to assemble the entire engine. Through bolts have been

turn to p. 108

Fig. 2 (left) – Mock-up of the 2-cycle light plane engine.

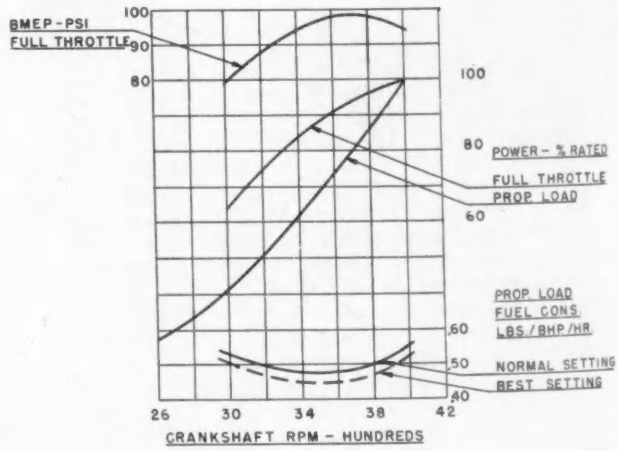
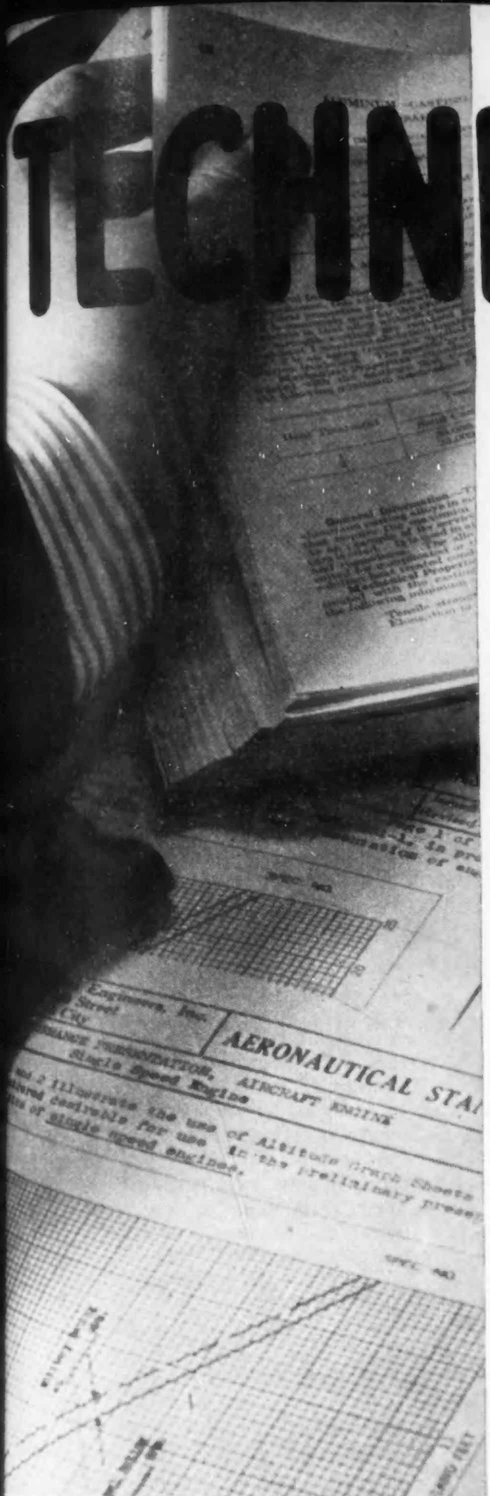


Fig. 3 (above) – Performance curves of a 3-cyl 2-cycle aircraft engine predicated from single cyl tests



TECHNICAL COMMITTEE PROGRESS

SAE Standards To Douse Fire Due to Engines

With the use of tractors, trucks, motorized implements, and stationary internal combustion engines growing by leaps and bounds, the hazard of fires caused by sparks, flame, and combustible vapors shooting out of exhaust pipes has presented a problem of rather large proportions.

Now, at the instigation of several of the interests most affected, the SAE is tackling the problem. Through a new committee authorized by the SAE Technical Board and under sponsorship of the Tractor Technical Committee, it will attempt to develop specifications for exhaust system spark and flame arresters on internal combustion engines.

The problem is particularly acute in the logging industry and forestry service, in oil fields, around refineries, in cotton and other fabric warehouses, and with the ground handling equipment at airports. And of course sparks and flame have always been a hazard on the farm during threshing season.

In our forests some 200,000 fires yearly exact a toll of about $40,000,000, burning 30,000,000 acres of forest land and destroying millions of animals and birds. A portion of this annual devastation is traceable to mechanized equipment operated in wooded areas in both logging and farming operations.

On the farm there is always danger of ignition of the chaff accumulating on tractors and threshers either from heat, sparks, or flame from tractor exhaust.

At airports there is the hazard of sparks or flames from tractors which tow planes. Sometimes this occurs when an ungassed plane is being towed; sometimes when the tractor passes a plane that is being gassed.

Some states have attempted to set up regulations. There are certain CAA and ATA regulations covering the handling of fuels around airports. The U. S. Forest Service requires spark arresters on

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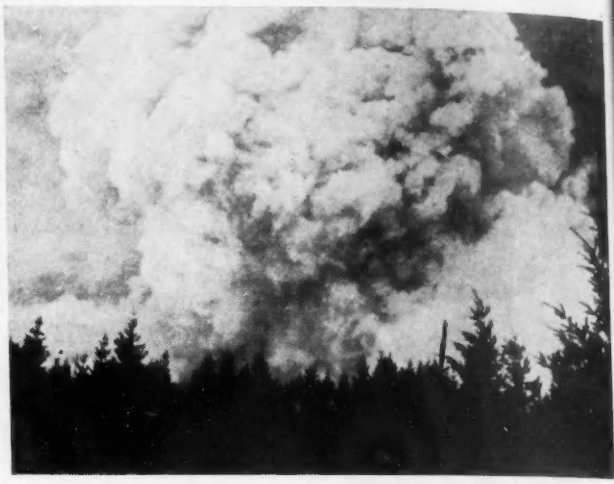
This May Lead to This



Flame and spark arrester standards for tractors and other vehicles will help prevent widespread devastation by fires. SAE Flame Arrester Committee is now working on such standards. (Note proximity of tractor's exhaust pipe to overhanging bush in photograph at left depicting underbrush clearing in a forest. Absence of a spark arrester invites danger of conflagration such as that shown at right)

tractors used in the woods; but there are no standards, no uniform recommendations, and no one knows what constitutes adequate protection.

It is not possible to tell the tractor operator just what to do to protect the dry underbrush or the overhanging leaves and branches from spark and flame. Sometimes they just attach a tin can. Until now the problem has been one of an emergency nature for which some remedy is usually cobbled up.

The new technical committee undertaking this problem is under the direction of Technical Board member C. G. A. Rosen, Caterpillar Tractor Co. It has been formed and held its first meeting. Chairman of the committee is W. W. Lowther, Donaldson Co., Inc. Other members from industry are C. A. Hubert, International Harvester Co.; J. A. Rotham, United Airlines, Inc., and R. C. Williams, Caterpillar Tractor Co. D. M. Hamilton is from the U. S. Forest Service.

In assigning Mr. Hamilton to the committee, Lyle Watts, chief of the Forest Service, expressed great interest in the project and praised the Society for taking the initiative in bringing the technical experience and skill of industry together to work out a uniform practice which will result in prevention of millions of dollars in devastating fires every year.

Among the assignments which the committee members have undertaken is a survey of existing regulations in various states covering spark arresters. An inquiry will also be made into what the Bureau of Mines has done with respect to equipment operating in dangerous mine atmospheres.

Existing test data on spark arresters now being manufactured will be sought throughout industry. All possible data concerning the fire hazards, conditions of tractor and internal combustion engine operation in oil fields and around refineries will be sought, while an investigation will be made into measures that have been taken by the railroads to combat the dangers of fires from sparks.

Lumbering interests are keenly appreciative of the seriousness of fire hazards from diesel-powered tractor and truck exhaust systems. The Northern Idaho Regional Forestry Association, now supervising research on this very problem at the University of Idaho, has expressed willingness to cooperate fully with the committee.

Members of the committee have shown a high degree of enthusiasm for the project as many new angles and ramifications have revealed themselves. They are confident that an SAE recommendation and standard will be forthcoming that will end all hit and miss emergency methods of bottling up sparks and flames.

Plastic Car Windows Practical Says SAE Safety Code Proposal

THE stage will be set for legalizing use of plastics in automobile and bus windows if SAE recommendations for revision of American Safety Code Z26.1 are accepted by American Standards Association, to whom they have just been submitted. The recommendations – made by SAE Plastics Glazing Committee – detail revisions which would include transparent plastics for the first time in the code which so far has permitted only safety glass.

As revised, the code would permit four kinds of glazing materials:

1. Laminated glass (plate, sheet, and combinations of plate and sheet)
2. Heat-treated glass
3. Wire glass
4. Plastics.

With one exception, the recommendations do not specify which of the four materials shall be used in particular applications. The exception: windshields should be made only of safety glass. Plastics Glazing Committee members agreed unanimously that no plastic material yet developed will successfully withstand the abrasive abuses to which windshields are subjected.

The recommendations define plastics (for glazing purposes) as either a single sheet of synthetic plastic material or a combination of two or more such sheets laminated together by an intervening layer of a more highly plasti-

cized material. To satisfy glazing requirements, the plastic must not produce more than a specified amount of distortion or interference with vision, strength, and clarity. Freedom from distortion must not be affected by temperature changes as normally encountered or by chemicals used about a motor vehicle for cleaning or other purposes.

Determination of these properties is covered in recommended test specifications applying specifically to these plastics. They include weathering tests, abrasion resistance tests, chemical resistance tests, and dimensional stability or warpage tests. No recommendations were made to change original code specifications referring to glass. Wherever possible, however, original safety glass tests were adapted to the plastics tests.

The committee recommended that the proposed code not be made an actual part of any state law or equivalent thereof. In the light of rapid developments being made in plastics, it was felt that inflexibility of laws might tend to retard such progress.

The recommendations resulted from 10 months work by the Plastics Glazing Committee and were based on extensive laboratory tests under the committee's auspices. (See SAE Journal, November, 1945, p.46; January, 1946, p.35, and February, 1946. p.70.) The committee's recommendations were approved recently by the SAE Technical Board before submission to ASA.

Test work leading up to the committee's conclusions included shot-bag pendulum fracture tests from different heights as well as ball tests conducted last December by the committee at the Ford Motor Co. (Fig. 1).

More recently subcommittees made up of main committee members from the glass and plastics industry made a thorough investigation of warpage of plastic materials in comparison with safety glass under similar conditions.

This group also conducted exhaustive tests to determine chemical resistance of plastic materials, in both a stressed and non-stressed condition, to all the most widely used window cleaning compounds and polishing materials. To augment these laboratory tests, the subcommittee ran a series of "filling station" tests on 12-in.-sq. pieces to provide actual field experience.

Fig. 1. – Shot - bag pendulum tests of numerous plastic glazing materials such as this one were conducted by the SAE Plastics Glazing Committee before arriving at recommendations to the ASA safety glass code

The committee confined its considerations to glazing requirements to ground vehicles in keeping with the original ASA glass code, although a number of requests were received to venture into other fields.

It is anticipated that the committee's work will greatly accelerate legal adoption of plastic glazing materials.

The Plastics Glazing Committee, under sponsorship of Technical Board Member R. H. McCarroll, is industry-wide in scope, including engineers of the automotive, glass, and synthetic plastics industries. Its carefully selected personnel include:

J. L. McCloud, Ford Motor Co., chairman; S. D. Douglas, Carbide & Carbon Chemicals Corp.; R. D. Dunlop, Monsanto Chemical Co.; V. C. Goggin, Dow Chemical Co.; C. E. Heussner, Chrysler Corp.; D. A. Hurst, Rohm & Haas Co.; G. M. Kline, National Bureau of Standards; W. R. Koch, Army Air Forces; G. M. Kuettel, E. I. DuPont de Nemours & Co.; R. A. Miller, Pittsburgh Plate Glass Co.; H. W. Mohr, Packard Motor Car Co.; W. M. Phillips, Research Laboratories Division, GMC; F. S. Spring, Hudson Motor Car Co.; P. W. Sullivan, Studebaker Corp.; T. Ulrich, Nash-Kelvinator Corp., and G. B. Watkins, Libby-Owens-Ford Co.

SAE PLASTICS GLAZING COMMITTEE took time out during impact testing of various transparent plastics at the Ford Motor Co. to be photographed for the SAE Journal

New Tests to Avert Helicopter Accidents

ANOTHER barrier to helicopter engineering has been hurdled by the newly released SAE Aeronautical Information Report No. 12, A Method of Ground Resonance Testing for Helicopters.

Ground resonance has been responsible for a number of serious experimental accidents. SAE Committee S-2, Helicopters, felt that developing a satisfactory means of detecting ground resonance in its incipient stages and bringing it to the attention of helicopter manufacturers – both present and prospective – would save the industry time and money.

Diagnosing defects in preliminary tests of new models allows sufficient time for remedial changes without inviting costly fatalities from unexpected failures. Destruction of an experimental machine, cost of which often runs well into six figures, retards development many months.

The Committee believes this to be a critical period in rotary wing development during which the future of helicopters may very well be determined. Elimination of impediments to progress such as ground resonance brings the

Fig. 1 – This two-bladed Bell Model 42 helicopter is being ground-tested for ground resonance, a condition that may lead to destruction of experimental craft if not discovered by such tests

goal of wide helicopter usage much closer.

Ground resonance, says the report, is a phenomenon arising from vibrations in the rotor's plane of rotation caused by sudden displacement of the rotor when a landing gear component touches. Augmented because of resonance with other aircraft elements, these vibrations can result in serious structural damage.

It may occur during take-off, hovering, landing, or even while the rotor of a grounded ship is rotating. Cases are known where the amplitude of vibration has built up during rotor pre-flight run-up to the point where the machines were overturned by their own energy and destroyed.

In analyzing ground resonance, helicopter engineers find it to be a coupling of periodic rotor-blade forces (a function of rpm) and other natural frequencies of the ship resting on the ground. Periodic forces applied at the rotor hub in the plane of rotor rotation are believed to vary with geometry and mass distribution of the blade system. Major sources of these forces apparently are:

1. Critical shaft speeds (whirling) caused by mass unbalance of the rotating system, a type commonly associated with critical speeds in shafting;

2. Blade motion about the drag hinge axis that seems to arise from blade motions in the plane of rotation, creating serious self-excited vibrations;

3. Miscellaneous unbalances from other sources in the rotor creating unbalanced centrifugal forces.

Tests Forecast Dangers

The Committee is satisfied the tests it developed for experimental machines using simple equipment will predict occurrence of critical ground resonance.

Recommended in the report is a complete survey of natural frequencies prior to the test for periodic blade forces. Items such as landing gear, rotor systems, and pylon systems should be examined individually for all possible coupled modes of vibration. Natural frequencies of these components usually can be determined by external excitation.

Second ground resonance ingredient, periodic blade forces, is detected and kept under control by a tie-down test during initial engine run-up on the ground. A level spot should be selected where footings can be sunk in the ground to take loads from the tie-down rig. The tie-down rig itself consists of a rigid framework surrounding the craft or a cable system from the pylon to ground tie-down points.

Provision should also be made for external excitation of the rotor hub or pylon during rotation. A separate cable, push-point, or one of the hub-restraining cables will do.

The test itself, continues the report, consists of starting at the lowest increment of rotor speed and violently displacing the hub in the rotor plane to induce forced vibrations. Damping response and the amount of force to produce a given hub displacement should be observed.

If all goes well, this should be repeated for several increments of rotor rpm. A resonant condition will become apparent either by a longer damping response period or by a noticeable reduction in force required to displace the pylon.

Tests should be started in low pitch, gradually increasing to high pitch with each increment of speed. This permits rapid pitch reduction should trouble develop. Fig. 1 shows a Bell Model 42 helicopter undergoing a ground test.

By controlling energy which otherwise might be destructive, these tests reveal the exact resonant speeds of the system. The engineer is forewarned of needed redesign before a costly accident serves the notice.

Preliminary data gathered by a subcommittee under R. A. Wolf, Bell Aircraft Co., formed the nucleus around which Committee S-2 developed this report. The Committee is chairmanned by R. H. Prewitt and includes Mr. Wolf; Commander R. E. Doll, Navy Bureau of Aeronautics; M. C. Gluhareff, Sikorsky Aircraft; W. L. LePage, Platt-LePage Aircraft Co.; J. P. Perry, G & A Aircraft, Inc.; F. Piasecki, P-V Engineering Forum; S. H. Rolle, CAA; and Lt.-Col. K. S. Wilson, Army Air Forces. Assisting the Committee on this project were R. A. Wagner, Kellett Aircraft Corp., and C. A. Moeller, Sikorsky Aircraft.

Full Program Keeps Tractor Group Busy

TRACTOR fuel classifications, fewer sizes of tractor tires and rims, the testing of vehicle mobility, wider base front tractor tires and rims, uniform wheel mountings and the development of a specification covering exhaust system spark and flame arresters are among the subjects dealt with by the SAE Tractor Technical Committee at its meeting in Milwaukee during the annual Tractor Meeting.

After some three years of study, investigation, and engine tests by tractor engineers and laboratories, followed by consideration by the Coordinating Research Council and the Tractor Fuel Classification Sub-Committee of the American Petroleum Institute's Automotive Research Committee, the TTC members approved two tractor fuel (not diesel) classifications for submission to the SAE Technical Board with the recommendation that the new classifications go to the SAE Fuels and Lubricants Committee for possible standardization.

Tractor engineers feel that the new fuel classifications represent a big step forward because it will be possible for tractor operators to purchase fuels of certain known classifications that are recommended by the tractor manufacturers. Again of marked importance, it is held, is the assurance of an octane rating of 35 minimum in the new fuel classification.

The two fuels are classified as "Tractor Fuel – Light" and "Tractor Fuel – Regular" and are as follows:

Tractor Fuel – Light

Distillation	
ASTM D86	
% Recovered:	Proposed
10%	347 F (Max)
95%	437-464 F
Octane Number	
ASTM D357:	35 Min

Tractor Fuel – Regular

Distillation	
ASTM D86	
% Recovered:	Proposed
10%	347-401 F
95%	465-518 F
Octane Number	
ASTM D357:	35 Min

As an aid to reducing the great multiplicity of tire and rim sizes that has grown to staggering proportions in the tractor industry, the Tractor Technical Committee has prepared a much simplified tire and rim list which tractor engineers hope to be able to follow in the design of future tractors. No attempt was made to reduce the number and sizes of tires and rims called for in the current production of tractors or in tire and rim replacement in the field; but it is believed that by using the simplified list as a guide to future design, the problem of manufacturing and stocking scores of different sizes of tires and rims will be reduced to a minimum in the future.

TTC recommended that the simplified listing be passed on to the Tire and Rim Association as a suggested recommended practice.

One of the acute problems which tractor engineers face is the growing practice of farmers and other users to overload the front end of tractors by the front-end attachment of implements for simpler operation. Overloading has reached the point where the proper functioning of tires, steering gear, axles, bearings and spindles is endangered.

Experimental Tire Designed

As a possible means of offsetting this practice on tractors now in service and without a major redesign of future tractors, the engineers in cooperation with the tire and rim companies have developed an experimental wider base front tire and rim. This will provide greater carrying capacity of the tires and thus relieve other parts of the front end mechanism of overload and undue strain. The experimental tires incorporate a greater number of plies and have a wider bead.

In the experimental program to be carried on by tractor engineers the present 3.00 in. rim is replaced by a 3.75 in. rim to accommodate the wider and heavier tire. A limited quantity of tires and rims of the new type have been produced and made available to tractor engineers only for experimental purposes.

A subcommittee of the TTC has launched a study of the problem of fire in dry grass, woods, stubble, oil fields, refineries, mines, airports and other hazardous localities caused by sparks and flames coming from the exhaust systems of tractors and trucks. An effort will be made to develop a specification covering functional requirements of exhaust system spark and flame arresters. (See story on p. 79.)

For more than three years a subcommittee of the TTC has served in a consulting and advisory capacity in aiding the Army Ordnance Department through its Aberdeen Proving Ground staff and facilities on the subject of vehicle mobility in highly plastic soils and in developing and conducting an experimental program on controlled soil testing.

Subcommittee members, following a recent review of the progress made by Aberdeen in the knowledge and procedure of testing both track and wheeled vehicles in highly immobile soils, expressed the belief that the program has reached the point where great practical value can be obtained from the data that have been accumulated. The committee members now propose to prepare a detailed evaluation of the experimental work done in the past two to three years.

Plan Simpler System For Metal Identity

OUTSTANDING item in the long range program planned by the SAE Non-Ferrous Metals Committee is development – if feasible – of a numerical indexing system to identify chemical composition of non-ferrous alloys, similar to the SAE steel numbering system.

Such a system will greatly aid both non-ferrous metal producers and users. It will simplify identification of these metals by offering an orderly system of classification.

Contemplated is a system of significant numbers that would be indicative of the basic element and the approximate constituent elements of each alloy specification. Committee members agree that such system should probably consist of only two or three digits, possibly in combination with letters, to avoid confusion with the four-digit SAE steel system.

W. E. Day, Jr.

Because of the amount of work involved in such an undertaking, the Committee does not anticipate completing the task before the end of next year. Varieties and combinations of non-ferrous alloys presently used makes this a more complicated project than was the steel indexing.

Another important announcement was made by Chairman W. E. Day, Jr., of Mack Mfg. Corp., regarding the reorganization of working subcommittees and establishment of a new program agreed upon at a recent steering committee meeting.

To refine and modernize more effectively specifications in the ever-advancing field of non-ferrous metals, there will be created a larger number of more specialized working committees. Presently, for example, the Light Alloys Subcommittee covers the entire field of aluminum and magnesium. Use of aluminum casting alloys is now sufficiently broad to warrant a separate working committee dealing solely with cast aluminum alloys. Same is true of wrought aluminums. Both of these industries have become well-defined in themselves.

There will be a new group for each of the following:

- Wrought Aluminum Alloys,
- Cast Aluminum Alloys,
- Cast and Wrought Magnesium Alloys,
- Bearing and Bushing Alloys,
- Cast Copper and Copper Base Alloys,
- Wrought Copper and Copper Base Alloys,
- Metal Joining Materials,
- Miscellaneous Alloys and Data.

Present organization of the Non-Ferrous Metals Committee will carry through for the balance of this year in completing work on the 1947 Handbook. Plans are to institute the new subcommittee structure at the beginning of the 1947 SAE administrative year. Until that time, working subcommittees will function under the following chairmen:

- Light Alloys – P. V. Faragher, Aluminum Co. of America;
- Copper Alloys – L. M. Lawton, Harrison Division, GMC;
- Miscellaneous – J. S. Laird, Ford Motor Co.;
- Metal Joining Materials – W. C. Schulte, Curtiss-Wright Corp., Propeller Division.

A new series of metal joining materials will be added to the SAE standards family in the 1947 Handbook. Included will be copper and silver base brazing alloys, welding electrodes, and solders. (See SAE Journal, July, 1946, pp. 30, 31.) This project was jointly sponsored by the Non-Ferrous Committee and the Iron and Steel Committee.

To be effected immediately for inclusion in the 1947 Handbook is a plan to present specifications for the non-ferrous group in a more uniform and convenient format to simplify Handbook usage. Over the years material standards have been prepared by different groups without sufficient correlation as to form. The steering committee agreed to rearrange all non-ferrous specifications as follows:

a. Introductory notes will include a brief historical background of the specification, information as to application, and any limitations;

b. General information on the distinctive types of metals and their use will be designed to further assist the

metallurgist and engineer in using the specification;

c. Tabulation of chemical composition and physical properties will complete the specification.

Helicopter Studies Soon to Bear Fruit

HELICOPTER engineering is advancing at a rapid gait paced by action taken at the last meeting of the SAE Helicopter Committee.

Individual members submitted reports on 18 different projects under way among which are: proposed symbols for rotary wing aircraft, desirable characteristics for helicopters, and design criteria for helicopter wheel brakes. Indications are that several projects have reached the stage where final reports can be expected shortly.

Chairman R. H. Prewitt welcomed the following new members to the Committee: W. F. DeGroat, Kellett Aircraft Corp.; M. Jensen, Bendix Helicopter, Inc., and C. L. Zakh, McDonnell Aircraft Corp.

Brake Group Charts Constructive Program

RECENTLY reorganized SAE Brake Committee has set up a tentative program of investigation and research aimed at aiding users, producers, and law enforcement agencies.

Its 4-point program centers about these projects:

1. Development of a standard method of measuring brake effectiveness;
2. Reducing number of brake lining sizes;
3. Investigating use of dynamometers in testing brakes;
4. Studying brake rating for possible development of nominal rating procedure.

In its program proposal the new Committee held that three factors are vital to the development of a standard method of measuring brake effectiveness. Of prime importance is a uniform method of measuring stopping distances along with suitable instrumentation for making the measurements. An effort will be made to develop brake testing apparatus other than the inertia type decelerometer, the gun strapped on the running board or the fifth wheel.

It was also felt that the Committee could be of material help to enforcement agencies throughout the country if it could develop and recommend a positive but much simplified method of testing brakes which could be used by any enforcement personnel.

Third factor in this part of the program has to do with developing a uniform sequence of tests for the purpose of determining the performance of brakes in the hands of vehicle operators.

Both passenger car (non-power) type of brakes and truck and bus (power) type of brakes will be considered in all work of the Committee.

As regards the second project, Committee members agreed that there is an urgent need for greater uniformity of linings for the same brake. Slight differences in brake lining sizes together with differences in the positioning of rivet holes and bolt holes in linings for the same brake have resulted in a great multiplicity of linings. Figures quoted from studies already made show, for example, that there are 120 combinations of lengths, widths and thicknesses and over 40 drilling patterns designed to fit 17¼ in. brake drums alone. Many of the lengths vary as little as ¼ in. and thicknesses as little as 1/64 in.

Although dynamometers are used and have been used by a number of manufacturers for testing brakes in much the same way that engines are tested, dynamometer testing of brakes was held to be only a weeding out process, the final determinations having to be made in vehicles on the highway.

However, considerable dynamometer data are available and an effort will be made by the Committee to correlate these data and, if possible, develop a test procedure for dynamometers similar to that now in use by the truck industry.

It is felt by the Committee that the last item on its program, development of a nominal brake rating procedure, could well lead to the establishment of a ratio of brake capacity. A method of rating brakes would serve as an evaluation of performance ability and nominal wear or life expectancy.

Organized brake activities in the SAE date back to the writing of the Hoover Code and the delivery of two well received papers on the subject of brakes by the late David Beecroft and B. B. Bachman, first chairman and now Technical Board sponsor of the Brake Committee.

The Brake Committee under the chairmanship of T. P. Chase, Research Laboratories Division, GMC, includes the following carefully chosen personnel: J. V. Bassett, Manhattan Rubber Mfg. Division, Raybestos-Manhattan, Inc.; C. J. Book, Truck and Coach Division, GMC; Burns Dick, Wagner Electric Corp.; F. K. Glynn, American Tel. & Tel. Co.; E. N. Hatch, New York City Transit System; Stephen Johnson, Jr., Bendix-Westinghouse Automotive Air Brake Co.; R. F. Kohr, Ford Motor Co.; Karl Pfeiffer, Chrysler Corp.; J. L. S. Snead, Jr., Consolidated Freightways Inc.; R. K. Super, Timken-Detroit Axle Co.; S. G. Tilden, S. G. Tilden, Inc., and A. E. Williams, Fruehauf Trailer Co.

SAE Felt Standard To Be Modernized

AN amended SAE Felt Standard commensurate with current commercial practice is being completed by the Non-Metallic Materials Committee.

Because of its many automotive applications, felt assumes an important position in the materials panorama. The part it plays in the vehicle is apparent in wipers, door bumpers, pedal pads, and dust shields. But it also serves a vital function in places where

W. M. Phillips

it cannot be seen – such as vibration mountings, ball and roller bearing oil-retaining washers, chassis strips, and dash liners.

SAE Felt Standards first made their appearance in 1923, under the auspices of the then Parts and Fittings Division. Most recent revision was made in January, 1940. The Non-Metallic Materials Committee – responsible for these standards since 1943 – is completing the first postwar revision to give automotive users the benefit of wartime experience in felt development.

First change being made is the incorporation of a new, comprehensive definition of felt. Says the revised standard, "Felt is a fabric built up by the interlocking of fibers by a suitable combination of mechanical work, chemical action, moisture, and heat, without spinning, weaving, or knitting. Felt may consist of one or more classes of fibers, wool, reprocessed wool, and reused wool, with or without admixture with animal, vegetable, and synthetic fibers."

Also defined in the introduction are the terms wool, reprocessed and reused wool.

Important from a practical standpoint are minor changes in weights, thicknesses, and permissible ash residue resulting from wartime improvements. For simplification, the eight thicknesses of ball bearing felt are replaced by four and the eight lining felt thicknesses replaced by two.

The five separate tables formerly provided giving felt classifications, density requirements, thickness tolerances, and chemical and physical re-

quirements will be combined in one table. This is a move to "standardize standards"; it will avoid confusion in checking felt specifications issued by the Government and other organizations that use the single-table form.

Chairman W. M. Phillips, Research Laboratories Division, GMC, has thanked the Engineering Committee of The Felt Association, on behalf of the SAE Non-Metallic Materials Committee for the valuable contributions it has made to the standard.

Triangle & T-Square To Tell Truer Tale

AERONAUTICAL Committee S-1, author of the recently released SAE Aeronautical Drafting Manual, is continuing pursuit of new techniques and developments to better the art of drafting.

At its first post-manual meeting, the conferees initiated a program to refine drafting delineation and interpretation to the point where there is no possibility of misunderstanding. This move was sparked by a recent committee survey that disclosed at least half a dozen common drafting notations subject to two or more possible interpretations.

By this and other projects considered for future enhancement of the manual, they hope to help the designer tell his blueprint story simply and clearly to the man in the shop.

Aero Oil Coolers Being Simplified

AIRCRAFT manufacturers and operators can now look forward – for the first time – to industry standards for oil coolers being developed by SAE Committee A-7, Heat Transfer Units.

To date the aviation industry has been dependent largely upon Army-Navy oil cooler standards. Extreme operating requirements were essential for military aircraft; each bomber, transport plane, and fighter had to be built to operate as well in the tropics as in the arctic regions. Oil coolers built to operate under such wide range of conditions are obviously costly and unnecessary for nonmilitary usage.

Operating conditions for commercial and personal planes are not nearly as stringent and are predetermined for each flight. For this reason nonmilitary accessories can be built to less rigid specifications – at less cost.

Course of action being followed by the Committee is to revise the AN standards, eliminating specialized military requirements. The conferees, under chairmanship of J. J. Hilt, Young Radiator Co., intend to prepare an Aeronautical Recommended Practice covering both personal planes and commercial air transports.

Main difference between the two will be the degree of cold weather operation provided for in the specification. It is proposed that oil coolers for commercial transports operate at –55 F and that light plane coolers provide for temperatures down to 0 F.

The National Aircraft Standards Committee was consulted and its recommendations aided materially in preparation of the ARP.

Serving with Chairman Hilt on Committee are W. H. Geddes, United Aircraft Products Co.; C. W. Harris, Wright Aeronautical Corp.; L. P. Saunders, Harrison Radiator Division, GMC; A. A. Brown, Pratt & Whitney Aircraft; G. W. McEntire, Airesearch Mfg. Co.; L. T. Miller, Glenn L. Martin Co.; F. R. Weymouth, Bell Aircraft Co., and J. P. Flannery, Aircooled Motors Corp.

Serrated Shaft Fittings Cheaper

BETTER-FITTING and less costly shafts are aimed for in the newly revised SAE Serrated Shaft Standard.

Serrated shaft ends are used largely for low torque fastenings such as brake shaft ends. Advantage of the serrated over the previously used tapered and square shaft ends lies in the simplified manufacturing of serrations plus the greater effectiveness of the fitting.

Production Costs Cut

Numerous costly manufacturing operations for tapered and square ends are replaced by simple broaching or hobbing in production of serrated shafts. An added complication with the tapered shaft is the need for keys.

Present SAE Recommended Practice for Serrated Shaft Ends mathematically is based on the sin wave. The

C. H. Stanard

subcommittee handling this project found the straight form generated by hobbing to be so closely related to the involute form that they agreed to designate it as a straight involute form. It is to be known as the 45 deg Involute Serration Standard – a companion to the SAE Involute Spline Standard.

In addition to the difference in form, there are other variations between the new and old standard. Adopted in the new standard were: even diametral pitches ranging from 10/20 to 256/512, diameters from 0.10 to 10.0 in., and from 6 to 100 teeth. Detailed information on tooth dimensions data necessary for gaging the serration are provided for each size.

But that's not all; even cutting tool dimensions for each size are detailed.

This standard will be included in the 1947 SAE Handbook.

Responsible for the development and preparation of the standard is a subcommittee of the SAE Parts and Fittings Committee. Its membership includes engineers from the automotive, aircraft, parts, and machine tool industries, namely: C. H. Stanard, Buick Division, GMC, chairman; H. H. Gotberg, Colonial Broach Co.; J. P. Breuer, Barber-Colman Co.; H. Pelphrey, Michigan Tool Co.; W. A. Siler, Delco-Remy Division, GMC; A. E. Leach, Pontiac Division, GMC; J. F. Kramer, Boeing Aircraft Co., and G. Trinkle, Illinois Tool Works.

Plastics, Jet Alloys AMS Being Pursued

WIDER aircraft application of heat-resistant alloys – especially in jet engines – and of plastics is being made possible by SAE Aeronautical Material Specifications, the first industry specifications of their kind in these fields.

At a recent AMS Subdivision meeting attended by 91 members and guests, plans were outlined for the development of specifications covering heat-resistant high-density alloys. Development of jet and gas turbine powerplants brought these alloys into prominence. High jet engine temperatures necessitate metals with greater flame-resistant properties than any previously required.

AMS under way will simplify the manufacturer's purchasing task as well as that of the raw material supplier. These specifications will be broken down into materials for the following engine items: wheels, buckets, tail cones, burner liners, compressor blading, welding rod, general sheathing materials, and high-temperature bolting. They will tie in with metallurgical research being conducted by NACA and other organizations.

Another new class of materials for which the aircraft industry is finding

many uses is plastics. In nonstructural applications such as flooring and airliner furnishings, plastics have proved to be particularly useful. But here again lack of final-product specifications made purchasing a chore.

This situation is soon to be changed by the issuance of SAE-AMS now being prepared. They will embrace plastic sheets, moldings, extrusions, and fabrics of varying composition as well as plywood and composition board.

Other phases of the subdivision's work also were acted upon. Copper alloy specifications were reviewed and brought up-to-date to reflect present industry practice and recommendations from suppliers. Changes made affected 25 copper alloy AMS.

The subdivision intends to render as complete a service as possible to users by making each AMS easy to use. Uniformity in both presentation and wording of the specifications is being studied by a newly formed editorial committee composed of the commodity committee chairmen.

Changes in membership announced by Subdivision Chairman J. B. Johnson, Army Air Forces, are as follows:

• H. Oster, Republic Aviation Corp., replacing J. Perina;

• J. H. La Rose, Packard Motor Car Co., replacing R. E. Van Deventer;

• R. C. Pocock, Bendix Aviation Corp., replacing A. J. Volz.

Spring-Driven Accessories May Reduce Plane Costs

STANDARDIZATION of a new aircraft accessory spring-drive arrangement planned by SAE Committee E-24 promises to eliminate many finely machined splines and substantially reduce engine and accessory manufacturing costs.

Committee S-24, Accessory Drives and Flanges, has found that a spring drive will transmit uni-directional torque from the engine to accessories such as generators as effectively as will a spline. Virtue of this arrangement lies in the great difference in manufacturing cost between spline and spring drives – another aid in the drive to reduce personal and commercial plane costs.

In this new configuration, the spring tightens on the shaft as power is being delivered and transmits torque from driving unit to accessory shaft by means of friction. It is planned that the spring will be helical with a constantly changing section to distribute the stress evenly.

Before any standards will be developed, the Committee will thoroughly test the device. Preliminary studies show that the spring drive may lend itself to a number of uni-directionally driven accessories.

Progress is also being made by the Committee on another important project – quick attach-detach accessories. (See SAE Journal, October, 1946, pp. 84, 85.) These devices will permit rapid removal and installation of engine accessories.

Chairman N. F. Rooke, Pratt & Whitney Aircraft, announced that agreement was reached at the last committee meeting to prepare a preliminary Aeronautical Recommended Practice. It will contain four designs submitted by Leece-Neville, Jack & Heintz, Bendix Aviation, and Victory Engineering. The proposals, in ARP form, will be submitted to aircraft engine and accessory manufacturers along with a questionnaire.

Based on the recommendations received, the Committee will decide upon one, and possibly two, quick attach-detach units for the final ARP to be issued.

Pursue New Standards For Fitter Fittings

THE ever-present challenge of an improved product uniformly engineered to give better results at less cost has motivated SAE Parts and Fittings Committee to develop new standards for three types of automotive pipe fittings.

At a recent Committee meeting in Detroit, plans were made to inaugurate standards on these three types of fittings in the 1947 SAE Handbook:

1. Pipe fittings and pipe plugs – for piping such as hydraulic lines;

2. Filler and drain plugs – such as those used in the axle case, transmission case, and crankcase;

3. Lubrication fittings – used on pressure and grease guns.

The large variety of these fittings used in automotive vehicles have always been designed by individual manufacturers with no degree of uniformity among the various companies. As with all standardization, benefits accruable from these standards will be the simplification of purchasing and stocking of basic and allied industries as well as savings in cost.

Chairman
C. G. Davey

Proposed standards will include coverage of shape and dimensions plus normal application and performance requirements. Each series of fittings standards will differentiate between type of material and method of fabrication – ferrous and non-ferrous, cast, extruded, and machined.

Chairman of the Fittings Subcommittee assigned these projects is C. G. Davey, AC Spark Plug Division, GMC. A. E. Leach, of Pontiac Motor Division, GMC, is chairman of the parent Parts and Fittings Committee.

Definitions Crystallized In Dual Propeller Field

CONTROVERSY and confusion in the field of dual, coaxial, and counter-rotating propellers caused by lack of uniform terminology can now give way to order and understanding. Joint effort of SAE Committees E-21, Aircraft Engine Components and Accessories, and P-6, Propeller Standards, has produced Aeronautical Recommended Practice 355 covering standard terminology for these types of propellers.

Quite often one company found that its nomenclature in this new propeller area meant something entirely different from that of another company. Misunderstandings and confusion jeopardized dealings between engineers even within the same plant. Clarification of the entire problem was made possible by a meeting of propeller and engine minds on this subject in SAE Aeronautic Committee activity.

What It Says

ARP 355 defines dual, coaxial, and counter-rotating propellers and components as follows:

1. Dual-Rotation Propellers or Dual-Rotation Propeller Shafts – The concentric arrangement in which each component of the propeller rotates in an opposite direction at the same speed because of a fixed gear ratio between shafts.

2. Coaxial Propellers and Coaxial Propeller Shafts – the concentric arrangement in which each component of the propeller rotates in an opposite direction wherein the speed of each component can vary independently because no fixed gear ratio is incorporated between the shafts.

3. Counter-Rotating Propellers and Propeller Shafts – the airplane arrangement in which shafts and propellers rotate in opposite directions but in which the shafts are not concentric.

4. Inboard Component – the component of a dual-rotation or coaxial propeller which is mounted on the inboard shaft. (Nearest to power source.)

5. Outboard Component – the component of a dual-rotation or coaxial propeller which is mounted on the outboard shaft. (Farthest from the source of power.)

6. Designation of Number of Blades – the number of blades of a dual-rotation or coaxial propeller shaft shall be designated as the total number in both components.

This new ARP shows promise of assuming international proportions. Except for a minor difference, the British find it acceptable to them.

Uniform Jet Engine Terminology Under Way

CREATION of a new committee on gas turbine nomenclature standards and dissolution of an old one on maintenance tools highlighted action by the SAE Aircraft Engine Subdivision at its last meeting.

Nomenclature standards are not new to SAE aircraft engine technical committee activity. Nomenclature Guide for Aircraft Engine Parts, ARP 341, was issued by another committee back in September, 1945. It covered largely the reciprocating engine field.

With jet and gas turbine powerplants coming to the fore, a need exists for the addition of a number of items pertinent to this new engine area.

The new committee, designated E-28, will review recommended additions to ARP 341 covering jet and turbine terminology, submitted to SAE by the Engine Technical Committee of the Aircraft Industries Association. It was agreed that this be a temporary committee, created specifically for the handling of this project.

Committee members appointed at the meeting are: K. C. Mehrof, Wright Aeronautical Corp., chairman; E. I. Babb, Pratt & Whitney Aircraft; W. Hattenplug, Aircooled Motors Corp.; A. E. Gibson, Packard Motor Car Co., and W. M. Tyler, Allison Division, GMC. It is planned that other individuals, whose knowledge and experience will be of value, will later be invited to serve.

Regarding the second item on the agenda, it was agreed that the present objectives of the Aircraft Engine Maintenance Tools Committee E-20 had been met and that it be disbanded. This group was responsible for development of standards for propeller-shaft wrenches, impact pullers, and wear gages.

Feeling that tooling standardization should not be dropped entirely, the subdivision gave responsibility for surveillance of turbine engine tooling standardization needs to Committee E-22, Turbine Engines. If definite problems develop, the Turbine Engine Committee will recommend to the subdivision the organization of a tooling subcommittee to handle them.

Addition of the following new members to the Aircraft Engine Subdivision was announced by Chairman C. E. Mines, Packard Motor Car Co.; S. R. Puffer, General Electric Co.; C. J. McDowall, Allison Division, GMC; G. F. Pearson, Jacobs Aircraft Engine Co., and W. B. Anderson, Westinghouse Electric Co.

Fig. 1 – Operators of public utility service trucks, such as this one, and many other vehicles will soon enjoy the benefits of two-way radio being developed by SAE Radio Communication Committee

Two-Way Radio Goal in Sight

FINAL report on two-way radio application in trucks, buses, and passenger cars is being whipped into shape by the SAE Radio Communication Committee.

Agreement has been reached on the form of the report and the material to be included, Chairman W. C. Baylis New York Power & Light Corp. announces. Comprising the report will be the following sections:

1. Summary – General information on application of units, range, and approximate cost.

2. Space – Description of equipment such as weight and size and available space for installation in each type of vehicle.

3. Power Supply – Power requirements for set in each type of vehicle, method of determining adequacy of generator and battery, and provisions for additional power if necessary.

4. Safety Precautions – Outline of electrical hazards in radio communication and recommended periodic inspections.

5. Federal Regulations – Regulations governing operating frequencies.

Complicating completion of the report are several constantly changing factors. A case in point is the cost of the unit; fluctuating production costs make accurate cost estimating difficult. Despite such problems the Committee has gathered all the necessary data and is now in the process of assembling the material for submission to and approval of the SAE Transportation & Maintenance Technical Committee and the Technical Board.

The members hope to make the report available for general distribution through the SAE Special Publications Department.

By reducing operating costs through better utilization of trucks and crews, two-way radio promises to aid fleet operators. It also should prove valuable to doctors, taxi cab operators, public utility companies, and fire departments. An installation in light trucks is shown in Fig. 1.

Only by integration of the knowledge of engineers from the transportation, vehicle, and radio industries in SAE technical committee activity could such equipment be effectively developed.

Eleven of the 13 Canadian SAE members who have received distinguished honors from King George VI for their war efforts in behalf of the British Empire are shown above. The emblem at the left is that of the Order of St. Michael and St. George, established in 1818 by King George IV. It was originally created to honor both military and civil British subjects in the Mediterranean area, and shows Archangel Michael on one side, and St. George slaying the dragon on the other. Mr. Carmichael received the Companion rank in this order, C. M G. Established by King George V in 1917 to reward both military and civil leaders for their work in World War I, one of the ranks of the Order of the British Empire carries the emblem shown at the right. On one side are reproduced the likenesses of King George V and Queen Mary, and on the other, Britannia seated. Commanders of the Order of the British Empire use the initials C.B.E., officers are designated by O.B.E., and members use M.B.E. Photographs of M. P. Jolley, O.B.E., and James Morrow, O.B.E., were not available at press time.

Now assistant director of engineering, Menasco Mfg. Co., Burbank, Calif., **HENRY C. HILL** had served as engineering manager, Special Propulsion Division, Wright Aeronautical Corp., Wood Ridge, N. J.

EDWARD G. SALTER is in Johannesburg, South Africa, having completed service as trade commissioner with the Government of Travancore, South India.

Transferred from General Motors Canadian Operations, **A. A. MAYNARD** is with Chevrolet-Cleveland Division of the corporation.

Formerly a project engineer with Bendix Marine Division, Norwood, Mass., **P. H. RICHARDSON** is with the Paragon Gear Works, Inc., Taunton, Mass.

DONALD S. FLYNN has been transferred to Kansas City, Mo., as Division manager of Ethyl Corp., from the same post at the North Kansas City Division.

SEBASTIAN FLORES is a mechanical engineer with Babcock-Wilcox Co., New York. He had been mechanical engineer at the Brooklyn Navy Yard, New York City.

C. DIXON EAGLE has resigned from Indiana Gear Works, Indianapolis, to join Motive Heat Treating, Inc., of that city.

Resigning as assistant to the manufacturing manager, American Bosch Corp., Springfield, Mass., **RAYMOND H. STOCKHARD** has been appointed instructor of mechanical engineering, Rhode Island State College, Kingston.

MICHAEL H. FROELICH is assistant to the publisher of Flying, Chicago aircraft publication.

CHARLES J. KOEBEL participated in the first convention of the Industrial Diamond Association of America which took place in July at the Book-Cadillac Hotel, Detroit. Mr. Koebel is second vice-president and a director of the association.

G. C. R. KUIPER, who had been staff engineer, Buick Motor Division, General Motors Corp., Melrose Park, Ill., has been appointed experimental engineer on product studies – Australian Operations, GMC, Detroit.

Members

JOSEPH PROSKE, deputy chief, Research and Development Division, Detroit Arsenal of the Ordnance Department, received the Exceptional Civilian Service Medal at a ceremony Sept. 17. The highest civilian award by the War Department was given for Mr. Proske's 35 years of continued service in the department and for his work on development of combat equipment.

Having served as Navy liaison for Wright Aeronautical Corp., **WILLIAM P. LESTER** is in the Service Division of the Wood Ridge, N. J., company.

ALBERT B. WILLIS, JR., has been elected president of National Capital Storage & Moving Co., Inc., Washington, D. C. He had been an automotive engineer with Socony-Vacuum Oil Co., Inc., at Paulsboro, N. J.

PEIRCE

A Wright Aeronautical Corp. engineer for 15 years, E. F. PEIRCE has been named manager of the special propulsion division. In his new post he will direct the company's development program in the field of new and advanced types of powerplants on which experimental work has already begun. He studied at Worcester Polytechnic Institute.

MOORE

DR. NORTON B. MOORE, director of engineering of the aircraft research and development division, was formerly manager of research with Aerojet Engineering Corp. He served as vice-chairman (Aeronautics), Northern Calif. Section, 1939-1940, and on the Aircraft Engineering Activity Committee, 1942-1944.

CLOWER

Formerly at University of West Virginia, JAMES I. CLOWER was appointed professor and head of the department of mechanical engineering, University of Delaware.

SHORT

SAE Past-President MAC SHORT, vice-president of Lockheed Aircraft Corp., is now in charge of Lockheed's military relations. Reporting to Lockheed President ROBERT E. GROSS, he will work with top military officials in planning development of a continuing program aimed at coordination of effort between Lockheed, and the Army and Navy.

SHATAGIN

Previously design engineer in the light car division of Chevrolet, JOHN T. SHATAGIN is now chief engineer of Ward LaFrance Truck Division, Elmira, N. Y. Before that he was associated with Graham-Paige, Briggs, and Budd in similar capacities. He studied at Columbia and Wayne Universities.

DOLL

HOWARD F. DOLL was promoted from chief engineer to vice-president in charge of engineering for the Victor Electric Products, Inc., Cincinnati.

New assistant general manager of Buchanan Electrical Products Co., Inc., Elizabeth, is **JAMES O. JOHNSON.**

Having been branch manager of the Sun Electric Corp., **JOSEPH A. DOYLE** was recently promoted to regional branch manager.

Elected as president of the Colyear Motor Sales Co., **RICHARD C. COLYEAR** served as executive vice-president.

Having recently been released as chief of Light Tank Engineering, U. S. Army, Office, Chief of Ordnance, **BRUCE M. DUNHAM** is now affiliated with the Sun Oil Co., as technical representative of the industrial sales department.

GERALD E. HYNAN has recently become production engineer of Jackson & Church Co., Saginaw, Mich., manufacturers of brick and pulp presses, molding machines, grey iron castings and structural steel and steel plate products.

Previously employed by Gustin-Bacon Mfg. Co., Chicago, **EDWARD A. SIPP** has become associated with the Reynolds Metals Co. as manager of the Railway Industrial Division.

Formerly connected with the Southern Railway Co. as supervisor of work equipment, **W. R. KENNEDY, JR.,** has joined Pontiac Master Auto Service.

WILLIAM H. CHANDLER, recently appointed design engineer, Maine Steel, Inc., was formerly assistant project engineer of Wright Aeronautical Corp., Wood-Ridge, N. J.

DAVIDS

Design engineer of the Fairbanks, Morse & Co., Beloit, Wisconsin, J. H. **DAVIDS** has been promoted to assistant chief engineer, Diesel Engine Division. He graduated from college in 1924 in Hamburg, Germany. His first connection with the engine industry in this country was with International Harvester Co., Rock Island, Illinois.

MAURER

PAUL H. MAURER, chief engineer of the National Pneumatic Co., Rahway, N. J., is responsible for all production engineering, research and development.

LAVERS

Having severed his connection as chief engineer of the farm equipment division of Graham - Paige Motors Corp., **A. W. LAVERS** is in the consulting field and will specialize in engineering consultation on tractors and farm machinery. He was chairman of SAE Gasoline Engine Division and Tractor and Farm Machinery Activity Committee.

EGGEN

O. E. EGGEN, who was previously director of engineering in the Chicago office of the Oliver Corp., is now plant manager of the Cleveland office.

New president of the Interprofessional Council of Wayne County is **CLYDE PATON**, consulting engineer, Ford Motor Co. Purpose of the organization is to improve standards of various professions in that Michigan community. A past vice-president of the Society, he served as chairman of the Detroit Section in 1934-35, was chairman of the SAE Engineering Relations Committee three years later, a member of the War Engineering Board and served as a member on numerous SAE technical and administrative committees.

A graduate of Harvard School of Business Administration, **WILLIAM M. SCRANTON** has just joined the U. S. Army.

LEE M. CORLESS has been appointed experimental test engineer of Hudson Motor Car Co., Detroit.

Engineering Service, Inc., of America, Detroit, has named **CLIFFORD M. HELLER** chief die engineer. He had been plant manager of Corning Glass Works, Corning, N. Y.

Ford Engineering Executives Named

Organization of the Ford Motor Company's Engineering Division on staff principles of operation has been completed, **HAROLD T. YOUNGREN**, director of engineering, announced. Several new departments have been added and the Engineering Division has been streamlined to promote improved efficiency and co-ordination between the major departmental units.

"Improvements in our engineering organization are in keeping with company plans for expanded engineering and research facilities to prepare for a greatly augmented line of cars, trucks, and tractors," Mr. Youngren said. Under Mr. Youngren, top departmental heads of the Engineering Division are:

YOUNGREN

WILLIAM S. JAMES, in charge of the research department. He was associated with Studebaker for 18 years as research engineer and, later, chief engineer. He is a member of the powerplant committee of the NACA, a director of CRC, chairman of a technical committee in the ASTM, and a past-president of SAE.

E. T. Gregorie heads the Styling Department. He began his career as a designer of fine yachts and was associated with Rolls Royce in New York and with custom body builders in London. He joined Ford in 1931.

V. Y. TALLBERG, a veteran Ford engineer, now heads the administration of the Engineering Division. At the outbreak of the war, he was Ford chief engineer in Cologne, Germany.

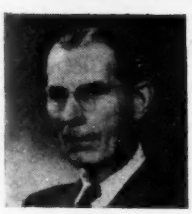
DALE ROEDER, who joined Ford in 1925, is chief engineer of the Commercial Vehicle Department which includes trucks, buses and tractors. He has been chief of commercial vehicle design since 1929.

Under the new setup, passenger car engineering has been divided into two separate departments with Lincoln-Mercury headed by H. H. Gilbert and Ford by **H. S. CURRIER**. Until recently, Mr. Currier was a chassis engineer at the Oldsmobile Division of the General Motors Corp. and had been with Cadillac, White Motor, Lafayette, and Studebaker.

L. L. BELTZ heads the Electrical Engineering Department. A graduate in electrical engineering from Michigan State College in 1921, he joined the Ford organization in December 1945. He previously had been with Reo, Studebaker, and Packard, where he was chief of electrical engineering.

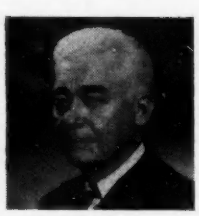
Test facilities of the Ford Motor Co. will be expanded and will co-ordinate all track, wind tunnel, and road tests, including the newly acquired test facilities at Phoenix, Arizona, for rigorous, year around road tests under extreme conditions, Mr. Youngren said. Heading this department is **ALBERT W. FREHSE**, who formerly was with the Chevrolet Division of General Motors where he held various executive engineering positions.

E. C. McRae is head of the engineering division's patent and vehicle department. He has been with the organization since 1919 and has headed the company's patent department since 1925.



BELTZ

CURRIER



FREHSE

JAMES

ROEDER

TALLBERG

JOHN CRAIG STEELE, having been honorably discharged from the U. S. Army, joined **Pratt & Whitney Aircraft, Division of United Aircraft** Service Corp., as foreign service representative.

After having served as hydraulics development engineer for the Pacific Division of Bendix Aviation Corp., **VERNE E. SYLVESTER** has been appointed senior design engineer for Airquipment Co.

Serving in the U. S. Army as drafting and design engineer, **JOHN F. CRANE** has joined Aerojet Engineering Corp. in the capacity of layout draftsman.

Previously employed as metallurgist, **EDWARD G. PEKAREK** was promoted to chief research engineer of Thompson Products, Inc.

Leaving the U. S. Navy, **ANDREW G. FARKAS** has become project engineer for De Mornay-Budd, Inc., New York.

ENSIGN **RALPH H. LONG, JR.,** who has been released from service, is now at Yale University as a graduate student.

Having been cooling engineer of Al-Fin Corp., **FREDERICK A. HIERSCH** is now affiliated with Continental Aviation & Engineering Corp. as thermodynamics engineer.

A. L. STANLY, propulsion engineer of Bendix Aviation Corp., Pacific Division, was formerly research engineer of Shell Development Co., Emeryville, Calif.

After serving with the U. S. Army Ordnance Department as automotive maintenance technician, **JOHN M. HEIMAN** is now connected with the Fruehauf Trailer Co.

Returning to Australia from a tour overseas, **GORDON BERG** has accepted a position as chief of the Airworthiness Section of the Provisional International Civil Aviation Organization in Montreal, Canada.

FRANK R. HINES is service representative for the Detroit Diesel Engine Division, General Motors Corp.

Formerly research engineer of General Motors Corp., **HENRY F. SCHULTZ** is now connected with Photocon Research Products, Pasadena.

JAMES H. WILLIAMS has recently been transferred from Los Angeles to the Erie, Pa., branch of General Electric Co.

Having been sales manager of the Des Moines, Iowa, branch of Ford Motor Co., **G. J. RETZLAFF** is now supervisor of the Richmond, Calif., branch of the company.

BENECKE

Formerly an instructor in the mechanical and general engineering departments of Iowa State College, ROBERT O. BENECKE has recently been appointed assistant professor and head of the engineering department, University of Omaha.

GRAHAM

CLIFFORD P. GRAHAM, who was chief engineer of Pacific Hard Rubber Co., & Western Molded Products Inc., is now with C. L. Tanner Co., Los Angeles, as chief engineer. In the past six years he has developed a line of hydraulic valves used in the oil well industry and for hydraulic press operation on which he has patents pending.

PANTHOFER

I. G. BOHRMAN, vice-president in charge of the radiator division of Perfex Corp., announced the appointment of ERNEST H. PANTHOFER as chief engineer of that division. In 1944 he became assistant to Bohrman.

ZUMSTEG

Coming to the United States in December, 1945, ERNEST J. ZUMSTEG, service manager of General Motors Overseas Corp., Batavia Branch, is again returning to Java, N.E.I.

Previously employed as district service manager of Autocar Truck Co., **RICHARD L. SMITH** is now connected with Victor Lynn Line, Inc., Salisbury, Md.

R. A. YOUNG, factory engineering representative with United Air Lines, Inc., has been transferred from Chicago to the San Francisco Maintenance Base of the company as powerplant project engineer.

After a period of service with the U. S. Foreign Economic Administration, **GEORGE B. FRAUMANN** has returned to his former post as transportation consultant for the Chinese Government in that country's Supply Commission, Washington, D. C.

MORGAN

WILLIAM C. MORGAN, JR., has accepted the position of sales manager of the original equipment division of the Walker Manufacturing Co. He will be in full charge of the car factory sales activities. His headquarters will be at Jackson, Michigan.

FLICKINGER

J. E. FLICKINGER is now head of technical sales for the Saval Co. As supervisor of aircraft procurement for American Airlines, Inc., he has familiarized himself with the latest trends in aircraft design and production methods in addition to having 3800 hours of commercial flying to his credit.

THARRATT

GEORGE THARRATT resigned from Lear Inc. of Calif., Hollywood, in order to conduct a business of his own as consulting engineer in production breakdown and illustration. His new office is located at 18041 Sherman Way, Reseda, Calif.

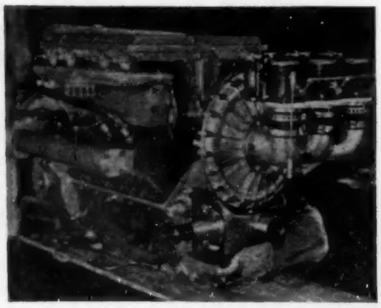
LARSSON

Leaving his position as engineer of the Swedish Intercontinental Airlines, A. B. Aerotransport, Stockholm, GUNNAR B. G. LARSSON has joined the Swedish Royal Board of Civil Aviation as assistant inspector general.

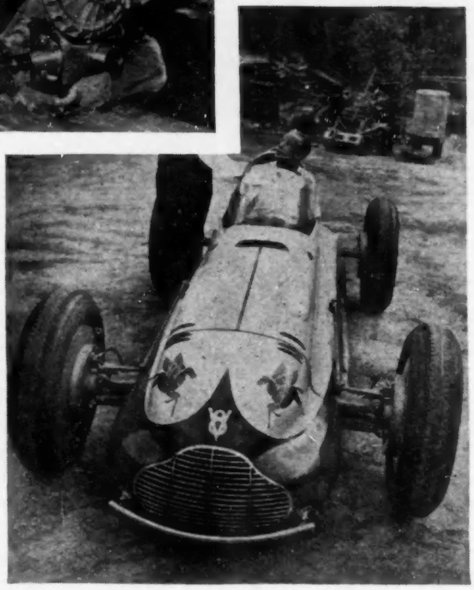
STANLEY W. MIKULKA has been promoted from turbosupercharger application engineer to supervisor of aircraft gas turbines, flight test group of General Electric Co., Los Angeles.

PAUL H. RICHARDSON has announced his resignation from Bendix Aviation Corp. as project engineer and his appointment of assistant plant superintendent of Paragon Gear Works, Norfolk, Mass.

Formerly service engineer of S. K. Wellman Co., Cleveland, **ROBERT WILLIAM MOWERY** has joined the engineering department of Black Industries of that city.



Engine and Racer



AB JENKINS, in a 1900-pound racing car, hopes to break his own speed records in a series of high speed tests at Bonneville Salt Flats near Salt Lake City, Utah. Standing only 36 in. high, the racer incorporates a number of new features for such cars. Its size and weight make it seem like a midget beside the Mormon Meteor, big four-and-a-half-ton in which Mr. Jenkins set a speed record of 177.83 mph for 500 miles, at Bonneville in 1940. In the new car he hopes to better 200 miles in the first hour, to cover 500 miles in two and a half hours, and 4000 miles in 24 hours. In addition to trying for a new speed record on the test run, Mr. Jenkins expects to supply technical information to fuel, lubrication and design engineers.

The engine is hand-made and uses water injection to increase thermal efficiency and horsepower. This 183-cu. in. motor produces 550 horsepower, compared with the 260-cu. in. engine which develops around 100 horsepower. The engine, of the V-8 type, weighs only 470 pounds without the transmission.

JOSEPH TRACY in the Locomobile he drove in the 1906 Vanderbilt race on Jericho Turnpike, Long Island, and which again drove in the Glidden Tour starting from New York City, Aug. 17, 40 years later. The 1946 tour included Albany, Syracuse, Rochester, Buffalo, aboard ship through Lake Erie to Detroit, where the group were guests of the Ford Motor Co. and General Motors Corp.; thence to Cleveland where Thompson Products, Inc., was host, and on to Columbiana, Ohio, where the Firestone Tire & Rubber Co. was host.

ROTH

Formerly project engineer with Thompson Products, Inc., Cleveland, JAY M. **ROTH** is now serving as chief engineer of Mechanisms Co., Uhrichsville, Ohio.

McQUAID

HARRY W. McQUAID, who recently resigned from Republic Steel Corp., as assistant chief metallurgist, has opened his own offices in Cleveland as a metallurgical consultant.

The 1946 Gantt Medal will be awarded to **PAUL G. HOFFMAN** for "providing an inspiring, practical example of successful management-labor relations in a free society preserving the best traditions of the American heritage of individual dignity, democracy and personal responsibility and for able leadership in developing private and public management policies to promote the general welfare by fostering a stable national economy." He has accepted appointment as a member of the 100-man U. S. National Commission on educational, scientific, and cultural cooperation. Set up by the State Department, the group will serve as a direct and permanent link between the United States and the United Nations Educational, Scientific & Cultural Organization. Mr. Hoffman, who is president of Studebaker Corp., was named to the new Commission as a representative of the Committee for Economic Development, of which he is chairman of the board of trustees.

J. M. GWINN, JR., recently chief engineer of personal aircraft for Consolidated Vultee Aircraft Corp., and director of tooling for the company during the war, has announced his resignation. He designed the two-control Gwinn Aircar, which received an approved type certificate in 1938, and has complete control of certain patent claims on two-control aircraft without rudders. Mr. Gwinn, whose headquarters are in San Diego, Calif., plans to study the private-owner airplane field and particularly the possibilities of the flying automobile.

Serving in the U. S. Army as captain, **PHILIP B. ROCKWOOD** is now mechanical engineer for the Cleveland Transit System.

Before becoming engineer for United Air Lines, Inc., South San Francisco, **JOHN DRAKE ROGERS** was in the Army.

KARL A. WALTER, formerly with Fisher Body Division, Fleetwood Plant, General Motors Corp., as tool engineer, has been transferred to the Fisher Body Central Engineering Division, Experimental & Development Section, as senior designer.

Recently being honorably discharged from the U. S. Navy, RUSSELL D. HUBERT will work for Ladish Drop Forge Co., Cudahy, Wis., as engineer in the metallurgical department.

Graduating from Massachusetts Institute of Technology, W. J. GAUGH has announced his acceptance of a teaching position with Texas A & M.

FREDERICK LAWRENCE BRASH has become affiliated with the Cleveland Diesel Division of General Motors Corp., Cleveland, as layout draftsman.

MERTON HARRY BLANK, manufacturers' agent, is specializing in hydraulic couplings at 16663 Whitcomb Ave., Detroit 27. He was formerly vice-president in charge of sales and engineering of the Liquid Drive Corp., Holly, Mich.

Before being elected as executive vice-president of National Skyway Freight Corp., "The Flying Tiger Line," Los Angeles, G. O. NOVILLE was associated with the Royal Dutch Shell, The Hague, The Netherlands, as aeronautical consultant.

JOHN D. BALDWIN, JR., who was manager of the Glendale Division of the Weatherhead Co., has been promoted to aviation engineer of the same company.

CAPT. WATSON AMBRUSTER II, formerly with the U. S. Army Air Force, Wright Field, has recently become a member of the U. S. Air Advisory Mission to the Chinese Government.

LT.-COL. WILLIAM C. MORGAN, JR., having been discharged from the U. S. Army, has been named sales manager of the Original Equipment Division, Walker Manufacturing Co., Jackson, Mich.

Resigning from Lockheed Aircraft Corp., A. WHEELER WARREN has become associate research engineer for Boeing Aircraft Co., Seattle.

Having been assistant to the chief of the planning equipment branch, U. S. Army Air Force, NICHOLAS POST has been promoted to technical assistant to the chief of the Analysis Division, Intelligence (T-2), Wright Field.

Returning to civilian life, STANLEY F. PATYRAK has accepted the position of executive assistant for Kaiser Frazer Corp., Willow Run, Mich. He served as a lieutenant in the U. S. Navy Bureau of Aeronautics.

RHOADS

ALBERT E. RHOADS recently resigned from Kuhlman Electric Co., Bay City, Mich., as executive vice-president and general manager in order to become president of a newly organized company, Engineering Castings, Inc., which is located at 600 S. Kalamazoo St., Marshall, Michigan.

EDGE

Relinquishing the position of senior assistant director in charge of all wheeled vehicle development for the fighting services at the Ministry of Supply, S. H. EDGE has become chief engineer for Clayton Dewandre Co., Ltd., Lincoln, England.

KENNEDY

The appointment of SCOTT M. KENNEDY to the position of zone manager was made by Maremount Automotive Products, Inc. He will work with district managers on the sale and distribution of the company's products. Mr. Kennedy has had extensive experience in the automotive field, having worked with automotive replacement parts for 17 years.

LEISTER

FAYETTE LEISTER, veteran of a quarter-century of service as an antifriction bearing engineer, has been elected by directors of the Fafnir Bearing Co., New Britain, Conn., to the office of vice-president in charge of engineering. A native of Philadelphia, he received his degree in mechanical engineering in 1917.

HENRY T. GIERYN, who has been discharged from the U. S. Navy, is now employed by Westinghouse Corp. in Philadelphia.

VIKRAM N. MEHTA, who is now engineer with Premier Automobiles, Ltd., Bombay, India, was connected with Chrysler Corp., Detroit.

Until recently designer with Wilcox-Rich Division, Eaton Mfg. Co., Marshall, Mich., ROBERT E. ONLEY is structural designer with Planet Corp., Lansing.

GEORGE C. PRILL is manager of the CAA Liaison Office of Pan American-Grace Airways, Inc., at Lima, Peru. He was formerly an engineer with Trans World Airlines, Kansas City, Mo.

Resigning from Lycoming Division, Aviation Corp., as a product test engineer, HILBERT S. RADER is a development engineer with Aluminum Co. of America, Cleveland.

DONALD R. McINTYRE is sales engineer with Bay Cities Equipment Co., Oakland, Calif., a subsidiary of Moore Equipment Co., Stockton. He had been a development engineer with the latter concern.

FRED BOATRIGHT was promoted from general foreman to engine overhaul division foreman, assembly and repair department, U. S. Naval Air Station, Corpus Christi, Texas.

Since his release from the armed forces, MARLBORO K. DOWNES has accepted the position of assistant district airport engineer of the CAA.

DAVID C. EATON has accepted a position with Taylor Turbine Corp., after having served Wright Aeronautical Corp. in the capacity of field engineer.

ALBERT H. DEIMEL is now chief engineer of the hydraulic transmission division of Spicer Mfg., Division of Dana Corp. He had been assistant chief engineer of the same organization.

Promoted to project engineer of Wright Aeronautical Corp., DALE E. WILKINS was assistant project engineer.

Having resigned as field service engineer of the National Supply Co., in Springfield, Ohio, DONALD W. COX is now associated with Auto-Marine Engineers, Jacksonville, Fla.

VICTOR NEWTON, who is a graduate student at City College, N. Y., was released from his duties as private in the U. S. Army.

PVT. WILLIAM M. KOENIG is stationed at Camp Lee, Va., having left International Business Machines Corp. at Poughkeepsie, N. Y.

Now field director, Los Angeles Center No. 3, War Assets Administration, ROBERT P. HAYWARD was an assistant and consultant on machine tools. He saw military service as a production engineer, U. S. Army Air Forces, at Los Angeles.

HENRY F. GOELZER is an instructor at the University of Wisconsin Extension at Milwaukee. He had been a student of the Massachusetts Institute of Technology.

DANIEL T. DOBROGOWSKI has recently been appointed chief engineer of the Milwaukee Stamping Co., after having served as mechanical engineer there.

R. E. KARVONEN resigned from the position of research and laboratory technician, Wilcox-Rich Division, Eaton Mfg. Co., in order to conduct a business of his own.

R. K. JACK, who had been chief engineer, Reo Motors, Inc., has been named chief engineer of the Divco Corp., Detroit.

Recently discharged from the U. S. Navy, **FRANK J. BREITSAMETER** is now employed as railway service engineer of Hyatt Bearing Division, General Motors Corp., Chicago.

After having served the National Advisory Committee for Aeronautics, Cleveland, **RAY E. BOLZ** has become graduate assistant at Yale University.

Resigning from the position of analytical engineer of the Baldwin Locomotive Works, Eddystone, Pa., **DR. THEODORE H. GAWAIN** is now assistant consulting engineer of the Aircraft Gas Turbine Division of the De Laval Steam Turbine Co., Trenton.

GORDON M. BUEHRIG, who was manager of the South Bend Studio of Raymond Loewy Associates, has now become vice-president in charge of designing for American Sports-Car Inc.

Having been vessel allocations assistant for the War Shipping Administration, Detroit, **LT. MAX M. McCRAY** has joined the United States Maritime Commission as tanker operator.

Superior Foundry, Inc., Cleveland, is the name of a new corporation which has purchased the facilities of the Superior Foundry Co., according to **G. J. FEISS,** who has retired as president and general manager of the predecessor concern.

HAROLD R. UHRICH has been appointed chief analytical engineer of the Aeromatic Propeller Division, Koppers Co., Inc., Baltimore, having resigned recently from Platt-LePage Aircraft Co., Eddystone, Pa.

Prior to joining Ethyl Corp. research laboratories as research engineer, **KARL BEAVER** was a lieutenant in the U. S. Navy.

Graduating from Yale University, **RUSSELL FREDERICK BRAY, JR.,** has been appointed junior test engineer of Pratt & Whitney Aircraft, East Hartford.

Construction engineer with Packard Motor Car Co., **EUGENE S. CLARK** has been named designer of the same company.

A former lieutenant-commander, **GEORGE LEONARD NEELY** has joined Standard Oil Co. of Calif. as manager of the lubricants division.

Formerly a mechanical engineer for the NACA in Cleveland, **RINALDO BRUN** is now connected with Mason Laboratory in New Haven, Conn.

Before becoming supervisor of the solids mechanical division of Armour Research Foundation, **WILLIAM A. CASLER** was research engineer of the mechanics division.

HOWARD E. GRAY, who was formerly principal automotive adviser, U. S. Army, field artillery, Camp Roberts, Calif., is now with the shop retraining division, Medical Rehabilitation Dept., Veterans Administration Hospital, Palo Alto, Calif.

ELMER F. DE TIERE, JR., has announced his new association with American Bosch Corp. of Springfield, Mass.

Previously working for the U. S. Army Ordnance Department as chief of the wheeled vehicle section, **WILFRED G. BURGAN** is now attached to the War Department in the capacity of mechanical engineer of the maintenance branch, Service, Supply & Procurement Group.

Transferred from California, **THOMAS B. ROSCOE** is field service representative of the Curtiss Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

JAMES CARROLL McDAVID is a mechanical engineer in the Special Products Department, Blue Ridge Glass Corp., Kingsport, Tenn. He had been with the Mills Motor Co. of that city.

Until recently a project engineer with Rheem Mfg. Co., Pasadena, Calif., **DAVID J. KIPP** is the owner of Kipp Ceramics of that city.

LARRY T. KENDALL is a student engineer at the Grand Rapids Fisher Body Division, General Motors Corp. He had been a student at the G. M. Institute.

Becoming chief engineer of the Servicycle Western Corp., San Francisco, **EDWARD H. ALLEN** resigned from his former position as experimental engineer with Treen Engineering Co., New Orleans, La.

Until joining the Midwest Research Institute as research engineer, **WILLARD R. BEYE** was senior engineer working on powerplants for Transcontinental & Western Air, Inc., Kansas City, Kan.

THEODORE D. BUETTELL has become methods analyst of Douglas Aircraft Co., Inc., upon leaving the U. S. Navy.

U. ADRIAN BRETING, JR., who was project engineer of the power transmission group of General Motors Corp., Allison Division, has advanced to the position of designer of the transmission section.

D. B. HOOSER is now employed by the Shenango Penn Mold Co., Dover, Ohio, and engaged in the mechanization of the foundry.

Upon his resignation as test engineer from Mack Mfg. Co., Plainfield, N. J., **JAMES H. M. BOAS** has become sales manager for the Ray K. Martin Co., Readng, Pa.

Formerly project engineer of Wright Aeronautical Corp., Wood-Ridge, N. J., **H. W. CLAPPER** is now manager of the Metals Division, Reeves International, New York.

CHARLES O. BECH, who was with the Farrel-Birmingham Co., Inc., in Buffalo, has just retired from business.

Before obtaining the position of operations manager of the Caribe Airways, Inc., Miami Springs, **HARRY C. ARCHER** was formerly associated with Grumman Aircraft Engineering Corp., as flight test engineer.

ROBERT C. AUSTIN, previously experimental engineer for B. F. Goodrich Co., has become proprietor of the Austin Ignition Co., Akron.

Chairman of the Student Activity Committee of the Washington Section, **GEORGE A. BARKER** is now an engineering consultant. Until this time he was an engineer for the U. S. Ordnance Department.

GEORGE E. AGNEW, previously with Consolidated Vultee Aircraft Corp. as design engineer, left that company to take the position of chief engineer with the Coatesville Plate Washer Co., Pa.

Resigning as mechanical engineer, National Advisory Committee for Aeronautics, Cleveland, **JERRY GLASER** has joined Northrop-Hendy Co., Hawthorne, Calif., as design and test engineer.

WING COMMANDER W. B. F. MACKAY, who saw service as chief engineering officer, Royal Canadian Air Force, is now on the faculty of the School of Mines & Metallurgy, University of Minnesota, Minneapolis.

Transferred from South Bend to the Ridgway, Pa., plant of Pharis Tire & Rubber Co., **ANDREW C. MATHIESON** is now chief engineer of the company's Molded Plastic Division.

CLOYD DICKERSON, who had been an experimental engineer with Packard Motor Car Co., has joined the engineering staff of the Lincoln Division, Ford Motor Co., on developing engines.

Now development engineer with the Mechanical Goods Division, General Tire & Rubber Co., Wabash, Ind., **D. F. MYERS** recently resigned as an engineering consultant with Studebaker Corp., South Bend.

WALTER J. O'DONOHUE is now senior inspector of the Chicago office of the War Assets Administration.

Recently resigned as research engineer for Stewart Warner Corp., **LEWIS A. RODERT** is now chief of Flight Test Branch, National Advisory Committee for Aeronautics.

HENRY F. SCHULTZ has been elected vice-president of Photocon Research Products, Pasadena. A former engineer at the Research Laboratories Division, General Motors Corp., Mr. Schultz is concentrating his attention on design and manufacture of electronic and scientific instruments and equipment.

Now assistant chief engineer of McCulloch Motors Corp., Los Angeles, **LT.-COL. JOHN C. THOMPSON** served during the war with the U. S. Army Signal Corps.

CLARK A. FISHER has joined the Engineering Section of Trans World Airlines, Wilmington, Delaware. He had been an engineer with Seaman Motors, Milwaukee.

LT. ALFRED EARL CREEK, who had been in the U. S. Army Air Forces, has joined the Allison Division, General Motors Corp., Indianapolis.

CHARLES M. JAMIESON has organized the Jamieson Aircraft Co., Municipal Airport, DeLand, Fla., specializing in the manufacture of light aircraft. He had been a design engineer with Beech Aircraft Corp., Wichita, Kan.

New chief engineer of Barrett Machine Tool Co., Meadville, Pa., is **GEORGE W. DAGGETT.** He had been production manager of Erie Engine & Mfg. Co., Erie, Pa. Besides machine tools and special machinery, the company manufactures small gasoline engines.

CAPT. ALFRED L. W. SEFFARDT, who served during the war in The Netherlands Army as an automotive engineer, is now mechanical engineer and chief of the drawing office of N. V. Machine-en Motorenfabriek, v/h Thomassen en Co., deSteeg, Holland. The concern manufactures diesel and gas engines, compressors, and oil field equipment.

Until recently a student at the University of Wisconsin, Madison, **RUSSELL E. BAETKE** is now an instructor at the University's Extension in Milwaukee.

CHARLES E. BIERWIRTH, who had been a student at the General Motors Institute of Technology at Flint, has joined the corporation's Buick Motor Division as a co-operative student.

Resigning from Ranger Aircraft Engine Division, Fairchild Engine & Airplane Corp., Farmingdale, L. I., **GEORGE B. BOSCO, JR.,** has joined Aerojet Engineering Co., Azusa, Calif., as a development engineer.

Until recently an ensign in the U. S. Navy, **GORDON A. GETTUM,** a graduate of Illinois Institute of Technology, Chicago, is with the Toledo Machine Tool Co., a division of E. W. Bliss Co.

DONALD B. HOOSER is production equipment engineer with the Shenango-Penn Mold Co., Dover, Ohio.

Before becoming draftsman for Power Industries, Inc., North Plainfield, N. J., **JOHN E. KELLY** served as tool designer with Clark Babbitt Engineering Association, Newark, N. J.

Released from active duty at the Bureau of Aeronautics, Washington, **JAMES H. FOOTE, JR.,** has joined the engineering staff of Ethyl Corp., Research Laboratories, Ferndale, Detroit.

Appointment of the 1946-47 Cupola Research Committee of the Gray Iron Division of the American Foundrymen's Association has been announced by **T. E. EAGAN,** division chairman, Cooper-Bessemer Corp., Grove City, Pa. **R. G. McELWEE,** Vanadium Corp. of America, Detroit, will continue as chairman of the committee. Other SAE members are **A. L. BOEGEHOLD,** General Motors Research Laboratories; **H. BORNSTEIN,** Deere & Co., and **E. C. JETER,** Ford Motor Co.

H. DELMAR CHITWOOD, who was a pilot engineer in the U. S. Army Air Forces, is now with Beech Aircraft Corp., Wichita, Kansas, as aeronautical engineer.

HAROLD S. HANSEN, mechanical engineer of the University of Southern California, was recently discharged from the Navy.

Until becoming test engineer for General Electric Co., Schenectady, **BENJAMIN J. LEHMAN** attended post graduate school at the U. S. Naval Academy, Annapolis, while serving in the U. S. Navy.

Previously studying at City College, **EUGENE WEINSHENKER** has been named mechanical engineer of Etched Products Co., Long Island City.

Formerly assistant manager of the Auto-Aircraft Division of the Pneumatic Tool Co., **ROBERT B. WICK** is now salesman for McDonald & Co. and Trautman-McCann Motors, Inc., both in Cleveland.

Resigning as senior technical officer of the British Air Commission in Washington, **THOMAS WILLIAM CLAVELL** has become chief of the aircraft engine dvision of the British Supply Office.

CARL B. COOPER, manager of the tire sale department of Goodyear Tire & Rubber Co. of Canada Ltd., has been promoted to general sales manager.

Receiving his master's degree in mechanical engineering from Purdue University, **THADDEUS W. CZUBA** has joined Curtiss-Wright Corp., in Columbus, Ohio, as research engineer.

Formerly sales engineer of the Los Angeles Die Casting Co., **FREDERICK W. DADSON** is now field engineer for Rogers Pattern & Foundry Co., also of Los Angeles.

JAMES ROWLAND DOYLE, who joined the University of Toronto as special lecturer, previously served as project engineer for General Motors of Canada, Ltd.

Until he became production engineer for the Nineteen Hundred Corp., St. Joseph, Michigan, **JOHN F. DANIELSON** was customer engineer of Bendix Products Div., Bendix Aviation Corp.

A graduate of Purdue University, **HERMAN H. BEMENT** is employed by Grumman Aircraft Engineering Corp. in Bethpage, L. I., N. Y., as flight test engineer of the powerplant group.

At present **GEORGE P. WILSON** is assistant engineer at the Armour Research Foundation, Chicago. His former position was that of graduate assistant at the Texas Agricultural & Mechanical College.

JAMES M. SMITH, who recently resigned from the Byron Jackson Co., has been appointed hydraulic engineer of Ryan Aeronautical Co., in San Diego.

Both formerly at Purdue University, **EARLE LEWIS SWANSON** has become cadet engineer of Northern Indiana Public Service Co., Hammond, Ind., and **ROLLAND DALE HUFF** is junior project engineer of the United States Rubber Co., Mishawaka, Ind.

OLIVER W. INSKEEP resigned from his position as automotive project engineer wth Harris Manufacturing Co. in order to establish his own business. The Oliver W. Inskeep Co. is located in Stockton, Calif.

ENSIGN JOHN LESTER FLETCHER, having been honorably discharged from the U. S. Navy, has become aeronautical engineer of Boeing Airplane Co., in Seattle, Wash.

Leaving American Airlines, Inc., **WILLIAM R. BARRY** is now connected with the Glenn L. Martin Co., in Balti-

more. He holds the title of senior liaison engineer.

JOHN A. WATKINS is a student engineer with Fisher Body Division, General Motors Corp., St. Louis. He had been a student at General Motors Institute, Flint, Mich.

Formerly a student at Purdue University, **NORMAN RUSSELL MEISE** is now with the Research Division, United Aircraft Corp., Hartford, Conn.

HOWARD EDWARD LOVEJOY is assistant marine superintendent of the Puget Sound Freight Lines, operating six vessels and a fleet of trucks, with headquarters at Seattle. He had been construction supervisor and recently finished building a 178-ft freighter for his company.

KENNETH KASSCHAU, former project engineer of Wright Aeronautical Corp., Wood-Ridge, N. J., is on leave of absence and is now a senior mechanical engineer, Clinton Laboratories, Monsanto Chemical Co., Oak Ridge, Tenn. He had served on the Metropolitan Section Governing Board as House Committee Chairman for several years, and was elected Secretary of the Section for the 1946-47 term.

DAVID FELD, formerly U. S. Navy, has currently accepted a position as installation engineer, Bell Aircraft Corp., Niagara Falls, N. Y.

GEORGE H. COMPTER, who had been chief production engineer, Link Aviation Devices, Inc., Binghamton, N. Y., is now employed by Industrial Conversions, Inc., New York, in the same capacity.

Previously mechanical engineer, National Advisory Committee for Aeronautics, Aircraft Engine Research Laboratory, Cleveland, **EVERETT P. GARRATT** has recently become powerplant engineer, Curtiss-Wright Corp., Airplane Division, Columbus, Ohio.

HARRY T. WOOLSON, recently returned from England, reports continued progress toward unification of screw thread practices in countries using the inch system of measurement. (Mr. Woolson, an SAE past-president and executive engineer, Chrysler Corp., went abroad to represent the Sponsor's Council—organized by SAE, ASME and ASA with **W. L. BATT** as chairman—in connection with international screw thread unification work. Mr. Batt also made the trip and participated in discussion with British engineers.)

Responding to a request brought back by Mr. Woolson, a delegation to discuss gaging problems went to England late in October. In the delegation were SAE Members **GEORGE S. CASE**, Samson & Sessions Co., and **FRANK P. TISCH**, Phoell Mfg. Co., as well as F. S. Blackall, Jr., Taft-Pierce Mfg. Co., and W. H. Gourlie, Sheffield Corp. This month a group of British engineers is due in United States to discuss tolerances.

LOGAN B. HELM is employed by Dictograph Products, Inc., New York, distributors of Acousticon Hearing Aids.

D. C. HEITSHU, John Deere Harvester Works, East Moline, Ill., had previously been executive engineer, Harry Ferguson, Inc., Detroit.

WILLIAM W. COLLINS has been transferred from E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., to the company's New York office, Development Engineering Division.

WILLIAM D. BOWMAN has taken a position as mechanical engineer, National Advisory Committee for Aeronautics, Aircraft Engine Research Laboratory, Cleveland, Ohio.

JOHN TILL is now service manager with Nick Ciliberti Motors Co., dealers in Plymouth and Dodge cars.

NIKOLA TRBOJEVICH, previously research and consulting engineer, Jack & Heintz Precision Industries, Inc., Cleveland, has organized Terbo Engineering Co., Detroit, of which he is owner and chief consultant.

Formerly design engineer, **JAMES L. WEBB, JR.**, has taken a position as chief draftsman, Techni-Finish Laboratory, Inc., Rochester, N. Y.

W. F. SEIFERT, who had been sales engineer, American Brakeblok Division, American Brake Shoe Co., Detroit, is now president, Freeport Industries, Inc., located in the same city.

MAJOR LEO TAMAMIAN, U. S. Army Signal Corps, has recently been transferred from ASF Training Center, Camp Crowder, Mo., to Frankfort, Germany, where he is group inspector in charge of Signal Corps installations in Europe, including the British and Russian zones.

WILLIAM J. HELLER, who served as senior mechanical engineer, U. S. Army Air Forces, ATSC, Wright Field, Dayton, is now affiliated with Harvey Machine Co., Inc., Los Angeles.

Upon release from active duty with the U. S. Navy, **J. DAVID HOPKINS, JR.**, enrolled in the Harvard Graduate School of Business Administration, to augment his engineering studies.

Formerly technical representative Wright Aeronautical, Ltd., Los Angeles, **FRANK DESMOND ST. HILAIRE** currently became affiliated with Lear, Inc., Electro-Mechanical Division, Grand Rapids, Mich., as a service engineer.

PROF H. W. RISTEEN has taken over the position of resident director of the new branch of the Michigan College of Mining and Technology, Sault Ste. Marie, Mich.

Upon discharge from the U. S. Army, Quartermaster Corps, **FREDERICK E. NEEF, JR.**, was employed by Standard Oil Co. of N. J., New York, N. Y.

I. C. SLEIGHT has joined the Materials Laboratory of Menasco Mfg. Co., Burbank, Calif., having resigned as chief metallurgist of P. R. Mallory & Co., Inc., Indianapolis.

Until recently a student at Michigan State College, **STUART A. HATH** is now a student engineer with Ford Motor Co., Dearborn, Mich.

ENSIGN F. H. LAMSON-SCRIBNER, JR., has been assigned to the U. S. Naval Repair Base, San Diego, Calif. He had been a student at California Institute of Technology.

Resigning from the Research Department, DeLaval Steam Turbine Co., Trenton, N. J., **KENNETH COOPER** is now with the Nepa Division, Fairchild Engine & Airplane Corp., New York City.

Formerly laboratory technician, Cleveland Diesel Engine Division, General Motors Corp., Cleveland, **WARREN J. DUBSKY** is now serving in the U. S. Army.

Until recently director of sales for Eclipse Machine Division, Bendix Aviation Corp., Elmira, N. Y., **GARDNER S. STAUNTON** is a manufacturers' agent in Detroit.

Upon his resignation recently as a special assistant in the office of the National Defense Research Council, Washington, **WILLIAM N. SHALLENBERGER** is now director of prosthetic devices of Vard, Inc., Pasadena, Calif.

LESTER L. ROBINSON is resident engineer at Pratt & Whitney Aircraft Division, East Hartford, Conn., for Bendix Stromberg Division, Bendix Aviation Corp. He had been the company assistant customer engineer at South Bend, Ind.

Formerly aide to the superintendent of transportation, Consolidated Gas, Electric Light & Power Co. of Baltimore, **JAMES ARTHUR RICHARDSON, JR.**, is civilian in charge of the Astrophysical Observatory, Quartermaster Board, Camp Lee, Va. Observations and computations of the sun's heat are made and radiation components are analyzed in testing textile materials for the Army Quartermaster Corps.

CLARENCE O. NELSON has been transferred from Syracuse to the Bloomfield, N. J., plant of General Electric Co., where he is now engineer in charge of the company's laboratories. He is working on air conditioning home heating and commercial refrigeration projects.

After serving in the U. S. Army and with the U. S. Merchant Marine, **RUBEN LESLIE STEVENS** has returned to Califor Publishing Co., Los Angeles, as technical editor.

JOSEPH RZECZYCKI has been transferred from Montreal to the New

York office of the Jet Helicopter Corp., where he is a design engineer.

Transferred from the Dallas office of Mack-International Motor Truck Co., **STEPHEN G. SCOTT** is wholesale manager of the company for Wyoming, Colorado, Kansas, and Missouri with headquarters in Kansas City, Mo.

Resigning recently as an aeronautical engineer with the National Advisory Committee for Aeronautics, Cleveland, **FRANK L. SUOZZI** is now an aerodynamicist with Cornell Aeronautical Corp., Buffalo.

G. H. BACH, vice-president of United Petroleum Gas Co., is now with the company's Minneapolis office, having recently moved from the Chicago headquarters.

Until recently a machine designer with Huff Bros., New York, **ALBERT CHARLES KELLY** is doing the same type of work for Serval Slide Fasteners, Inc., Flushing, Long Island, N. Y.

MAJOR JOHN CARL SILTANEN, AAF, has been transferred from California Institute of Technology, Pasadena, to Wright Field, Dayton, as an engineering officer.

WALTER L. PERRY, formerly at the Mt. Rainier, Wash., Ordnance Department in field stock control work, has been appointed principal of vocational education, Klamath County Unit School System, Klamath Falls, Oregon.

Discharged from the U. S. Navy as a motor machinist mate, 1st class, **FRANCIS JOHN NORTON** has joined the Army Ordnance Department as a mechanical draftsman at the Detroit Arsenal, Center Line, Mich.

Since his discharge from the U. S. Navy, **HILTON JULES LAFAYE, JR.,** has joined Goodyear Aircraft Corp., Akron, as senior designer on aircraft.

FRANTISEK LEOPOLD MAUTNER, who had been a member of the Czechoslovak Army, stationed in Great Britain, is now manager of The Asbestos Products Manufacturing Co., Ltd., Bombay, India.

CARL FREDERICK BREER, formerly a U. S. Naval Officer, Bureau of Aeronautics, Washington, D. C., is now assistant sales manager of McCullough Aviation, Inc., Los Angeles.

JOSEPH J. NUNN, who had been chief mechanical engineer, Guy F. Atkinson Co., San Francisco, has taken a position as chief engineer, Willamette Iron and Steel Co., Portland, Ore.

Prior to his association as partner in a consulting engineering firm, Washington, D. C., **BERTRAM ANSELL** was assistant engineer, National Bureau of Standards, same city.

J. C. ARMELING, formerly affiliated with Northrop Aircraft, Inc., Hawthorne, Calif., is tool designer, Airesearch Mfg. Co., Los Angeles.

Upon discharge from military service, **GILBERT ROTH** returned to the College of the City of New York, to complete his senior year as a mechanical engineering student.

JACK L. H. EVERITT, previously checker, engine design drawings, A. V. Roe, Canada, Ltd., Gas Turbine Division, Malton, Ont., Canada, is now a project engineer, S. F. Bowser Co., Ltd., Diesel Division, Toronto, Ont., Canada.

MAJOR CARL D. BECKER has been placed on the inactive list and has joined Linde Air Products Co., Buffalo, as an automotive engineer.

Having been in military service as an officer in the Ordnance Department Tank & Combat Vehicle Division, **ROY C. GRONE** has joined the Chicago office of the Texas Co. as an automotive engineer.

COL. R. J. HIGHFIELD, O.B.E., has returned from overseas service with the Canadian Army and has been appointed works manager of Williams Tool Corp. of Canada, Ltd., Brantford, Canada. He has been officer commanding of the Royal Canadian Electrical & Mechanical Engineers.

JOSEPH W. ALLEN has joined the Eclipse Pioneer Division, Bendix Aviation Corp., Teterboro, N. J. During the war he served as principal electrical engineer, U. S. Navy Bureau of Aeronautics in Washington.

Returning to civilian life from service with the U. S. Navy, **ROBERT J. SULLIVAN** is again laboratory engineer with the Research Department of Caterpillar Tractor Co., Peoria, Ill.

CAPT. CURTIS M. JESTER, Army Ordnance Department, has been transferred from Medford, Ore., to the First Ordnance Training Regiment, Aberdeen Proving Ground, Md.

Until recently senior project engineer, Wright Aeronautical Corp., **LOUIS DeROZE** has been appointed assistant to the general manager of operations of Menasco Mfg. Co., Burbank, Calif. For the past 16 years he has been in engine development and production work for the eastern engine manufacturing concern.

DANFORTH M. GOOGINS has been transferred to the South Portland, Maine, office of Socony-Vacuum Oil Co., Inc. He had been in the company's Worcester, Mass., office.

M. K. MEHTA has been assigned to the Bombay, India, office of General Motors India, Ltd., where his duties will include sales, installation and maintenance work on diesel engines, bearings, Delco equipment, and refrigerators. He has been in the New York office of General Motors Overseas Operations Division, and will spend a month in London at the corporation's Frigidaire factory for training before sailing for the far east.

LT. LEROY M. BECKETT, who saw duty with the U. S. Navy Air Station, Pearl Harbor, T. H., is now junior test engineer in experimental research laboratory, Pratt & Whitney Aircraft, Division United Aircraft Corp., East Hartford, Conn.

Resigning as assistant chief engineer of Towmotor Corp., Cleveland, **PAUL R. GUERIN** has been appointed assistant chief engineer of Johnston & Jennings Co., in that city.

STEPHEN duPONT is now president of the Tebs Co., consulting engineers in the field of small engines and their application, with offices in Springfield, Mass. He was formerly chief engineer of the Indian Motocycle Co. of that City, and was the representative of the American Motorcycle industry during the recent technical investigation of the automotive industry in Germany. He reported his findings at the SAE 1946 Summer Meeting at French Lick, Ind.

OBITUARIES

WILLIAM FRANCIS MARANDE

William Francis Marande, chief metallurgist of the Saginaw Division, Eaton Manufacturing Co., died suddenly on May 12, in Saginaw.

Chief metallurgist at the plant for years, he was an active member of Saginaw church, social and fraternal circles. Heart attack was blamed for the sudden death.

Mr. Marande had been with the Eaton organization for more than 21 years, being at the Saginaw plant the entire time.

He was born in Bay City, Nov. 22, 1899 and in 1921 graduated from the University of Michigan engineering school; then returned for a master's degree after a year with Industrial Brownhoist in Bay City. He got the second degree in 1923 and spent two years with Buick in Flint before coming here in 1925.

He joined the SAE ten years ago. He was a member of St. Mary's Parish, Holy Name Society and Knights of Columbus and was president of the St. Mary's St. Vincent de Paul Society. He served as both president and secretary of the Saginaw chapter of the ASM.

He had been active for years in Saginaw Tennis Club and was one of the 15 members who underwrote construction of the present club house. An active player, he was a director of the club and had handled all competitive

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News... ...OF THE SOCIETY

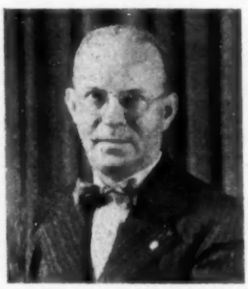
McCloud Heads Committee

UPON the resignation of A. L. Boegehold as chairman of the SAE Engineering Materials Meetings Committee, the group elected J. L. McCloud, Ford Motor Co. engineer in charge of chemical engineering, as committee chairman.

Mr. Boegehold, who is head of the metallurgy department, General Motors Research Division, was recently elected president of the American Society for Metals, and resigned because of the pressure of his added duties and responsibilities. He remains, however, as a member of the committee.

Other members of the meetings committee are:

W. H. Graves, executive engineer, Packard Motor Car Co.; C. E. Heussner, materials & testing division, Chrysler Corp.; R. F. Mather, chief metallurgist, Kaiser-Frazer Corp.; W. J. McCortney, in charge of the rubber and plastics laboratory, Chrysler Corp.; W. M. Phillips, head of the electrochemistry department, General Motors Research Laboratories; R. W. Roush, chief metallurgist, Timken-Detroit Axle Co.; C. J. Tobin, metallurgist for General Motors Corp., and E. W. Upham, chief metallurgist, Chrysler Corp.


J. L. McCloud


A. L. Boegehold

Section Membership Chairmen Welcomed

WELCOMING new Section membership chairmen to the SAE General Membership Committee, E. M. Schultheis, general membership chairman, announced the new quotas. The new section year, he said, started with a 16% jump over last year's like period.

Section membership chairmen were urged to organize their committees as early as possible so that all Sections would gain full advantage of the year's activity.

Chairmen of the various Membership Committees were urged to report to SAE Headquarters the names of their new committees.

Quotas set by the General Membership Committee for the new Section year follow:

Baltimore 24, Buffalo 24, Canadian 54, Chicago 120, Cincinnati 24, Cleveland 174, Dayton 36, Detroit 312, Hawaii 36, Indiana 48.

Kansas City 18, Metropolitan 282, Mid-Continent 18, Milwaukee 42, New England 36, Northern California 60, Northwest 42, Oregon 24, Peoria 18, Philadelphia 60.

Pittsburgh 24, St. Louis 24, Southern California 198, Southern New England 54, Syracuse 18, Texas 42, Twin City 24, Washington 66, Western Michigan 18, Wichita 18; total, 1938.

British Columbia 12, Colorado 12, Mohawk-Hudson 12, Salt Lake 12, Spokane 12, Virginia 18, Williamsport 12; total, 90. Out of Sections, 144; total, 2172.

Aid to Authors

TWO booklets are available from the SAE Meetings Department which prepared them to aid authors of SAE papers.

"Welcome to Our Family of SAE Authors" is the title of one which explains in general the requirements of the Meetings Department, and gives a few brief pointers on the preparation of the manuscript as well as on its presentation.

"Clear, Simple Illustrations" is the other. It points out that illustrations are the heart of a paper, whether presented in form of motion pictures, slides, or as engravings in the SAE Journal or the Quarterly Transactions.

Feature of this booklet is a sample curve sheet which shows the weight of lines in the original drawing.

CFR'S Future Bright, 25th Birthday Shows

TWENTY-FIVE years of cooperative research projects have yoked the scientific and engineering thinking of the petroleum and automotive industries in the public interest, speakers at the 25th anniversary of the Coordinating Fuel Research Committee, Sept. 18, proclaimed.

Veteran of this joint effort, Robert E. Wilson, now chairman of the board of Standard Oil Co. (Ind.), declared that need for increased cooperative research is greater than ever before.

More than 150 working members of CFR groups and research and management executives of the two industries heard several speakers refer to the three prime movers of the united research effort – SAE Past-Presidents Charles F. Kettering, the late David Beecroft, and the late Henry L. Horning.

CFR became a part of the Coordinating Research Council, Inc., which was incorporated under the laws of New York on Oct. 8, 1943. Its work is

jointly supported by the SAE and the American Petroleum Institute, whereas the CFR work was supported wholly by the SAE.

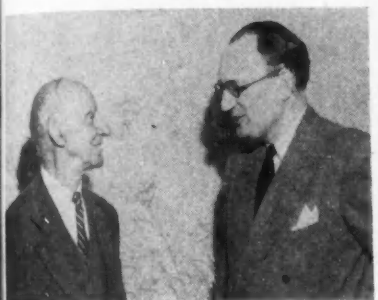
SAE Past-President James M. Crawford, CRC Board president, was unable to attend the celebration. C. E. Davis, vice-president of the CRC Board, read a telegram from Mr. Crawford, greeted the audience, and wished the organization continued success in its cooperative research work.

Mr. Davis, who is vice-president in charge of refining, Shell Oil Co., Inc., assured the technologists that the petroleum industry is solidly behind their work.

Membership of the SAE and API sent birthday greetings to CFR through John A. C. Warner, the Society's secretary and general manager, and William R. Boyd, president of API.

C. E. Davis, CRC vice-president, left, with John A. C. Warner, SAE secretary and general manager; William R. Boyd, Jr., president of the American Petroleum Institute, and Dr. Robert E. Wilson, chairman of Standard Oil Co. (Ind.), who was the dinner speaker. Mr. Davis, vice-president of Shell Oil Co., Mr. Warner, and Mr. Boyd brought greetings to CFR from CRC, SAE, and API, respectively

Veteran of CFR's formative period, Dr. H. C. Dickinson, a past-president of SAE, with T. B. Rendel, chairman of CFR's Interim Committee, chatting before the dinner staged under the latter's direction

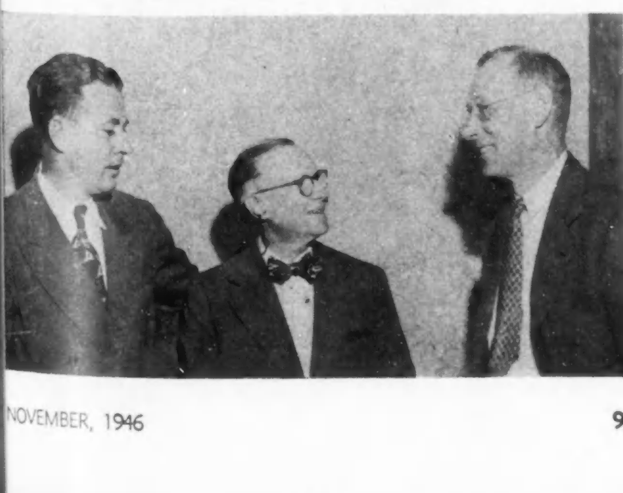


Representing the National Bureau of Standards, Automobile Manufacturers Association, and the American Standards Association were F. G. Brickwedde, left, Harry R. Cobleigh, and Brig.-Gen. Thomas Armstrong, respectively

Much of the work done during the past quarter century has been reported in cold type, Mr. Warner said, but of more importance have been the friendships made by petroleum technologists and automotive engineers which have enriched the lives of committee members and made emergency tasks during World War II possible.

The petroleum industry is convinced of the value of this cooperative research, Mr. Boyd said. Management executives have come to see that, despite research and development work being pushed with unprecedented vigor, cooperative work is complementary and must be continued.

Toastmaster J. B. Macauley, Ethyl Corp., with C. B. Veal, CRC general manager



Newest CFR leader is Gordon Murphy, left, and oldest in point of service attending the dinner was Herbert Chase, shown here chatting with B. B. Bachman, SAE member of CRC's executive committee of the board

Summarizing the achievements of CFR through the years, Dr. Wilson showed how its research reports, and SAE technical papers further expounded theories they developed, formed the structure of the technological advance of the two huge American industries, and paved the way for the specialized research on aircraft and diesel powerplants.

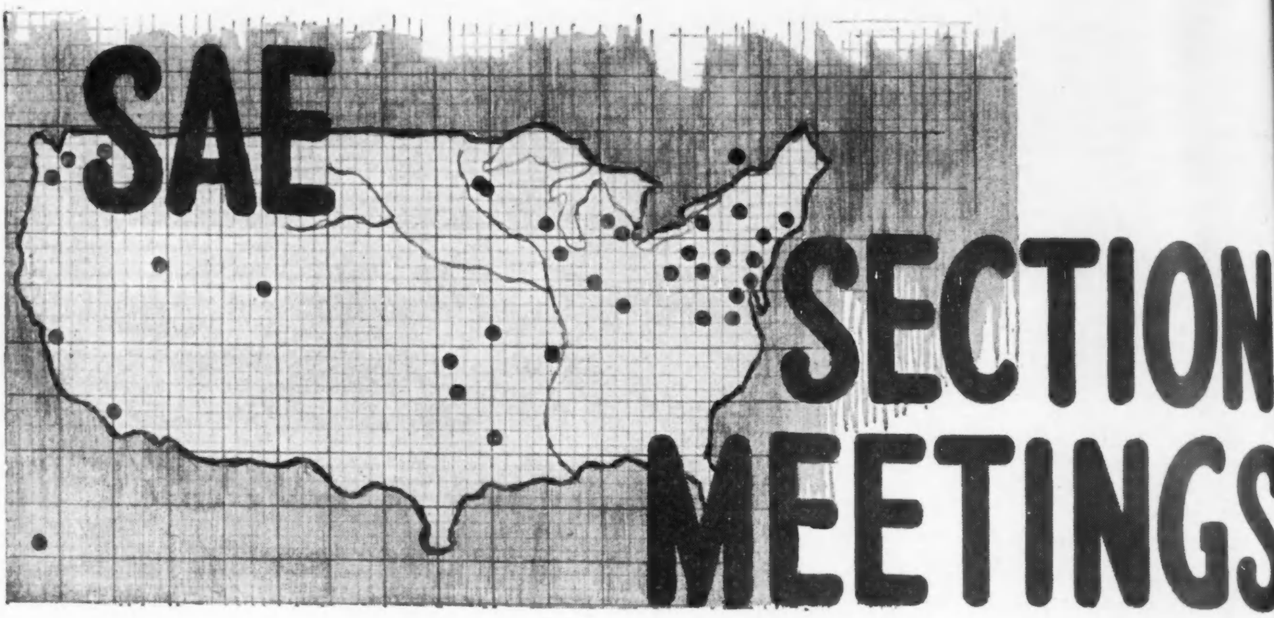
His citations of men responsible for the pioneering work in cooperative research and their technical contributions read like a "Who's Who" of SAE members, many of whom were struck with the relationship of their work to the present state of petroleum technology and engine development.

In his analysis of the march of technical progress in both fields, Dr. Wilson cited the successive technical achievements or management support of the work by E. W. Dean, L. H. Pomeroy, Mr. Kettering, Van H. Manning, Mr. Horning, SAE Past-President Henry L. Crane, C. C. Barry, G. A. Green, Coker Clarkson, SAE Past-President B. B. Bachman who was the first president of CRC and now is a Board member, Henry L. Doherty, Dr. T. C. Delbridge, G. A. Green, Edward S. Jordan, W. A. C. Smith, F. A. Howard, Frank C. Mock, C. K. Francis, O. C. Berry, Sir John Cadman, O. P. Keeney, A. W. Ambrose, and D. P. Barnard.

Continuing, he described the roles played by SAE Past-President W. S. James, R. E. Carlson, Stephen M. Lee, James E. Kendig, Urban J. Cook, Logan L. Lauer, Roger Birdsall, and H. K. Cummings, and how four of these men were killed in the cold room explosion at the National Bureau of Standards in 1923 – the only serious accident to befall a CFR project.

Dr. Wilson detailed the findings of SAE Past-Presidents H. C. Dickinson,

concluded on p. 104



Engineering Mixed with Quizzing in Detroit

by W. F. SHERMAN, Field Editor

DETROIT Section, Sept. 30 – The extremes of engineering measurement problems were revealed in two outstanding technical papers presented before the Detroit Section at its opening meeting of the season in the Horace H. Rackham Educational Memorial.

From one speaker the audience learned that ultra high-speed motion pictures are being taken at a rate so fast that if a jet plane were subject of the photography it would take 45 min to fly its own length on the projection screen.

From another, speaking on sound measurement, SAE members heard that "it would take the power generated by more than a million voices to light an ordinary light bulb."

C. D. Miller of the National Advisory Committee for Aeronautics, Aircraft Engine Research Laboratory, Cleveland, presented his paper with the accompaniment of high-speed motion picture photographs of combustion and detonation waves.

These pictures, also shown at the summer meeting at French Lick, are a result of seven years of research on the subject of gasoline engine spark knock. Taken at speeds of 40,000 and 200,000 frames per second, the photographs have been interpreted as suggesting and supporting a new theory of knock according to which this phenomenon is caused, in different cases, by auto-ignition of the fuel, by detonation waves, or by both.

"Heat and Sound Insulation," discussed by Laurence M. Ball, head of the Electronics Laboratory of the Chrysler Corp., Engineering Division, was amply illustrated with non-technical and humorous slides.

Thermal insulating materials were considered from the practical point of view of their function, selection and application. Mr. Ball pointed out that four items are of primary importance in keeping heat out of automobile and truck bodies: thermal insulation of dash and floor; sealing against infiltration of under-hood air; abundant supply of ventilating air, and shielding against radiation from the exhaust system.

Comparison of a wide range of insulating materials, "from rock to tissue paper, and from chopped corn fodder to pig hairs" reveals that the range of thermal conductivities is not greater than ±18%, Mr. Ball demonstrated.

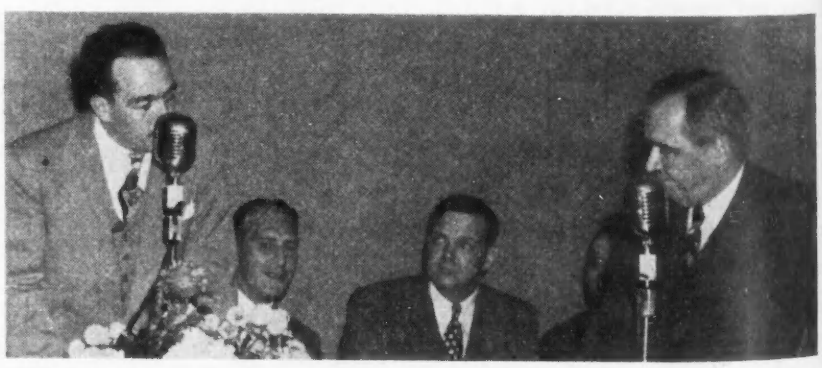
"So far as thermal conductivity alone is concerned, the engineer could not go far wrong if he picked his material blindfolded," Mr. Ball said. "He could do even better by noting that, for the materials listed, the lightest is nearly the best and the heaviest is nearly the worst. This suggests a pretty simple and useful rule: 'the lighter, the better.'"

With regard to sound insulation, he dealt chiefly with the psychological effects of sound. He gave a simple analysis of some psychological effects, along with a brief discussion of sound measuring instruments and their limitations. He discussed in detail and illustrated by slides and demonstrations that there are five basic steps in the solution of sound problems: reduction at the source, mechanical isolation, damping of resonant elements, insulation and absorption.

Approximately 800 members of the Detroit Section attended the meeting and about 550 attended the dinner which preceded it.

A lively quiz program staged after

Detroit Holds Own Quiz Program



Expert D. G. Roos (right) is quizzed by WJR's Ross Mulholland, master of ceremonies (left). Watching the performance, seated, are Detroit Section Chairman V. C. Young, Speaker C. D. Miller, L. I. Woolson, Chrysler Corp.

dinner, replacing the regular "coffee talk," was staged by Ross Mulholland, radio comic and quiz master of Station WJR, to open the fall session for the Detroit Section on Sept. 30 at the Horace H. Rackham Educational Memorial Building.

"Brass-hat victims" were William J. Davidson, vice-president, General Motors Corp.; Frank S. Spring, stylist, Hudson Motor Car Co.; E. H. Kelley, assistant chief engineer, Chevrolet Motors Division; W. H. Graves, chief engineer, Packard Motor Car Co.; Harold Youngren, executive engineer, Ford Motor Co.; Floyd Kishline, chief engineer, Nash Motors Division; D. G. Roos, vice president in charge of engineering, Willys-Overland Motors, Inc.

Engineers Shine

Stellar performances were given by the engineers. Davidson answered correctly that George Washington had red hair; Frank Spring correctly identified Mason and Dixon as surveyors who established the Mason-Dixon line; Graves quoted correctly the delivered price on a Clipper sedan, and Roos was correct in stating that U. S. Grant was the general buried near Riverside Drive, New York.

Kelley "struck out" on a question about the Star Spangled Banner because he thought it had been the national anthem for more than fifty years, and Youngren guessed that Bob Feller had only 80 strike-outs this season, instead of 348.

Numerous automotive questions submitted by the audience were posed to the "experts" and numerous merchandise prizes were awarded. Sensation of the evening was the general inability to remember the SAE horsepower formula, one of the questions.

CLOSING DATE

SAE Journal strives, in these pages, to bring to Society members live, prompt news coverage of every Section meeting. Material is provided by section field editors.

With dates determined by printing schedules, this issue covers all Section meeting news received in New York up to Oct. 15.

Informal Singing Livens Chicago's Playday

Golf and Roast Beef Give Flying Start to Section Year

by J. E. KLINE, Field Editor

CHICAGO Section, Sept. 20 – Three hundred SAE members and guests ate roast beef here today! They ate it at Westward Ho Country Club, ending the annual playday and golf outing which opened the 1946-47 Section year.

George C. Stevens and Orville Brouer, heading respectively the entertainment committee and the golf-outing committee, organized the festivities.

Guest-entertainer Ole Olsen awarded the 57 golf prizes for which 150 players had competed. Johnny Knapp did some real singing; everybody helped in the community singing, and the "Pretzel Benders" quintette sent music into the air throughout the afternoon.

■ ■ ■

What Goes on Behind Assembly Lines? GM Engineer Describes Proving Ground

by CARL E. BURKE, Field Editor

WESTERN MICHIGAN Section, Sept. 23 – Twelve hundred and forty acres of proving ground with a miscellany of test equipment for all purposes were described by Paul Huber, assistant director of General Motors' proving grounds, in a paper entitled "From Fifth Wheels to High Speed Cameras." Monthly average of car miles of test now is about 334,000 miles, he said, which is lower than the prewar schedule. Each gasoline station on the grounds pumps 850 gal per day.

After the 25,000 mile test of a new production car, the automobile is completely disassembled and laid out on long tables for inspection by members of the executive council and engineers of the division.

Fifth wheel is used to test road speed, fuel economy, acceleration and other automobile characteristics. Smoothness of acceleration and automatic shifts are indicated on a Staffon accelerometer used in conjunction with the fifth wheel. Fuel economy is measured by timing the flow through a burette; necessary steering force is determined by calibrated spring scales built into a wheel attached to the steering wheel.

Other important investigations are car measurements, moment of inertia determination, visibility, sound analysis, development of a torque wheel for determining torque at the driving wheels, and complete weight analyses of every part of the car.

by EARL S. TOMKINSON, Field Editor

PEORIA Section, Sept. 30 – "The General Motors Proving Ground can be thought of as acting as a landlord in providing testing facilities for the various GM divisions," said Paul Huber, assistant director of the General Motors Proving Ground, to a joint SAE-ASME meeting.

Although the proving ground runs and reports on tests of the products of the divisions, each GM division is completely and individually responsible for its own design and development work. The proving ground also acts as an overall inspection group and makes comparative tests on competitive products as well. Equipment for road testing and many other tests is developed by the proving ground staff but this development work is entirely separate from the development on the cars themselves.

Testing procedures, instrumentation and equipment used were illustrated by Kodachrome slides. On the test road one hill has a 27% grade with a short level section midway to duplicate conditions on certain streets in San Francisco. Traffic rules are strictly observed on the test road since traffic is heavy.

The concluding feature was a series of high speed movies used during the war to study machine gun breech action and recoil spring surge on the Oerlikon cannon. Then, "just for fun," Mr. Huber showed some extraordinary high speed movies of a mousetrap snapping on a finger, house flies and

bees taking off and in flight and, in Kodachrome, popcorn in the process of popping.

Usual length of durability runs is 25,000 miles. Longer runs are desirable but there is not sufficient time if findings are to be available for the next year's production.

Maintenance Problems Of Biggest War Measured

by BERTRAM ANSELL, Field Editor

WASHINGTON Section, Oct. 8 – The greatest war in history had a maintenance problem to match. There were statistical reasons, Col. Raymond O. Eliason told this meeting:

1. World War II required nearly six times as much materiel per man as World War I.

2. The average ton of materiel for Pershing took up 63 cu ft against 99 for Eisenhower; this means 57% more space in trucks.

3. Tonnage of vehicles in the ETO was 58 times greater in this war, and three times as much motor vehicle tonnage was lost in 1944 as in 1918.

4. World War II was the swiftest moving war in history.

5. Overloaded trucks were run at excessive speeds over poor roads to replace demolished railroads, furnishing supplies to an ever-changing front.

Tips Point to Added Generator Efficiency

by HARVEY MEACHAM, Field Editor

SPOKANE Group, Sept. 6 – A. M. Baump of the A. M. Baump Co. told members how to keep generators clean and in good working order. In his paper on "Fundamentals of Generators and Generator Control Devices," Mr. Baump mentioned the following ways of increasing generator efficiency to reduce operating cost:

- Joint between pole pieces and frame should be clean and have a full area of contact to the frame to reduce resistance to the passage of magnetic lines.

- Air gap between pole pieces and armature core should be as uniform as possible for uniform magnetic pull on armature core and uniform resistance to passage of magnetic lines.

- Connecting joints between coils and commutator bars should be mechanically strong to withstand stresses of centrifugal force at high armature speeds to prevent electrical losses.

- Cost per ampere will be reduced if generator is kept free from oil and as cool as possible.

Oil and Moisture in Insulating Material Blamed for Majority of Ignition Failures

by L. A. WILSON, Field Editor

MILWAUKEE Section, Oct. 4 – Ignition equipment is subjected to more hokum than any other part of a motor vehicle, according to Herman L. Hartzell, Ignition Engineer, Delco-Remy Division, General Motors Corp. Speaking on "Ignition Progress" at the October meeting, Mr. Hartzell declared that garage service men are apt to jump at conclusions in diagnosing ignition trouble, instead of using modern testing equipment with which every part of the system can be checked and the source of trouble located. He attributed most of the ignition failures to moisture or oil collecting on or seeping into the insulating material.

Failure of condensers has been such a common occurrence that many service men believe that this vital part of the ignition system should be replaced every 5000 miles, Mr. Hartzell said, whereas his company takes the position that a condenser, if properly constructed, should last as long as the car. He pointed out that paper condensers of ordinary construction will absorb moisture from air, and that impregnation does not keep the water out but merely slows down the rate of absorption. On this account, condensers on the shelf may deteriorate as rapidly as those in service. This problem has now been solved by putting the condenser into a sealed, moisture-proof container. At the same time another trouble – breakage of soldered connections – has been eliminated by arranging to have the connections made by pressure only. Long life depends on the package being tight.

Sealed Coils

In wax-filled ignition coils, moisture may penetrate between the first and second layers, causing break down. Since 1939 all GM heavy-duty coils have been sealed into a die-cast case by neoprene cork gaskets, trapped so they cannot squeeze out. Wax coils are still being made but it is planned to discontinue these and produce only sealed coils having a one-piece case and molded top.

Another replacement point is in the breaker contacts. The speaker recommended the use of a primary resistance of 1.2 ohm, rather than 1 ohm, to reduce trouble from oxidation of contact points. In winter this may have to be increased to 1.4 ohm. He stated that pitting can be controlled by properly balancing the system, but where a radio resistor blocks correction he recommended the use of a reversing switch.

The use of a heating element in the distributor cap is being considered as a means of avoiding trouble in the insulation at times when the distributor might otherwise be too cool. Rubber nipples should never be used, he asserted, because they may become oily and crack. Neoprene resists oil and withstands high temperatures well but must be selected for electrical prop-

Washington

Alwin A. Gloetzner

Washington Section kept its chairmanship in the family by electing for 1946-47 a native of the District – friendly, cheerful Alwin A. Gloetzner. He is a real veteran of the automotive engineering profession. He headed both production and engineering for the old Owen Motor Car Co. – after helping to organize the outfit to begin with. Even before that he had been production manager and purchasing agent for Oldsmobile. Then, later, he was chief engineer of the famous Chalmers organization – when that company was in its heyday. He has been an SAE member ever since 1912.

Right now he looks after New Departure interests in engineering, design, and procurement with various Government agencies, foreign governments, and private industry in the southeastern territory. His title is district manager.

Al is an ardent American League baseball fan – and a faithful spectator at college football games. His sports enthusiasm stems from his high school days when he starred in football, baseball, and track at Technical High School in Washington. He got his higher education at Columbian University (predecessor of George Washington University) and at Carnegie Institute of Technology in Pittsburgh.

In addition to his SAE activity, he is a member of the U. S. Army Ordnance Association, the American Society of Naval Engineers, and the Washington Board of Trade. – by Bertram Ansell, Field Editor

erties, he said. Sealed-in lubrication was advocated in place of a grease cup for the ignition shaft bearing, and lubrication of the breaker cam by use of a felt "cam wick" riding on the cam will keep a film of oil on the cam surface, resulting in long life without much wear. Preference was expressed for a neoprene cover rather than braid on high tension cables, to avoid trouble from oil.

With respect to spark plugs, Mr. Hartzell pointed out that the porcelain must have adequate mechanical strength, must provide good insulation at high temperatures, and withstand rapid temperature changes. Cracked porcelains, because of sharp edges, may cause detonation. Plugs may run too cool or too hot if not properly selected. He stated that plugs should be tested only with the engine running and the porcelain hot. Sometimes a weak spark is due to the formation of an ethyl lead coating on the porcelain.

On lean mixtures, a longer duration spark or a higher capacity spark may be needed, but frequently a wider gap or enrichment of the mixture will correct the difficulty. As the gap is widened the energy required to ignite the mixture decreases considerably. However, a longer discharge is obtained with a smaller gap, contrary to the opinion of some, Mr. Hartzell asserted. He pointed out that the voltage required depends on the compression pressure at the time of the spark, not on the compression ratio of the engine. New plugs have the tip of the center electrode cut squarely off, leaving a sharp edge. A used plug may, in time, require 50% higher voltage due to rounding off of the electrode, he said. Lean mixtures raise the voltage requirement about 40%, but there is a tendency to run on the lean side for economy.

The capacity of the connector and plug is much higher than the capacity in the rotor gap. The only case where a rotor gap interferes is when the voltage isn't high enough to break down the resistance. At low speed the breaker doesn't operate fast enough to give a clean break, and the minimum voltage may be only 40% of the maximum, the speaker said. Improved performance can be expected from use of a high-ratio coil (40 mmf secondary), a faster moving cam, and a larger condenser (0.2), it was indicated.

The higher the electrostatic capacity of the distribution system, the lower the voltage available at the plug. The speaker referred to recent tests with the compression ratio varied from 6.3 to 10.3 which had proved that the required voltage is higher the higher the compression ratio. Furthermore, the required voltage falls somewhat with an increase in speed, the drop amounting to about 30% from 500 to 5000 rpm in certain tests on an 8-cylinder engine using 10,000-mile plugs with .035 in. gap, and running at full throttle. Increasing the gap from .025 in. to .035 in. increased the voltage about 2000 volts over the entire speed range. He stated that the voltage can be increased considerably by going from the conventional 1-coil 6-volt system to a 2-coil 6-volt system, or to a 1-coil 12-volt system. The advantage of the 12-volt system when the plugs have a low insulation resistance was apparent from test curves projected onto a screen. The transformer designer simply adds more turns on the secondary winding if more voltage is desired, but such procedure makes very little difference in the case of an ignition coil. If the coil is placed close to the distributor with short leads, it can handle a compression ratio of 10 satisfactorily.

In discussing the practicability of

Buffalo

Paul E. Hovgard, Buffalo Section Chairman, has served the airplane industry continuously since his college days. In 12 years of test piloting, he has survived 5 bad crashes. He first cracked up from an altitude of 300 ft and stayed with the ship. After this experience, he demonstrated a preference for parachutes. The injuries sustained in his last crash prohibited further piloting.

Besides this activity, Hovgard has served as chief engineer, chief research engineer, and director of flight test for such companies as Travel Air, Keystone, Kellett, Pitcairn, Martin and Curtiss-Wright.

Paul E. Hovgard

He is now associate director of the Cornell Aeronautical Laboratory, where he integrates and supervises the technical activity.

A good speaker with a sense of humor, his part in any program is pleasantly anticipated. He says his hobbies are piano and bridge. Though not a pianist himself, he is Mrs. Hovgard's most appreciative audience. She has had several years of broadcasting experience. On the other hand, he admits he is a pretty good bridge player and is on the lookout for worthy competition. – by R. J. Marble, Field Editor.

These three biographies are the second in a series of articles about Section chairmen. Written by Section field editors, this will be a regular SAE Journal feature in the coming months.

Mid-Continent

Enos W. Cave

Enos W. Cave, chairman of the Mid-Continent Section, is assistant manager of Continental Oil Co.'s sales engineering division, with headquarters at Ponca City, Okla.

"Enie" was born in Waverly, Iowa, but moved with his parents to Chugwater, Wyo., as a child when his father became Continental Oil Co. agent there. He attended the South Dakota School of Mines and was graduated from the University of Colorado in 1934 with a BS in mechanical engineering.

Long an indirect member of the Continental family, he became an active part of it when he joined the company in 1935 in the sales engineering division, working on the development of Continental's Germ Processed and Nth motor oils. His promotions on the engineering staff have been numerous and rapid: in 12 years he has been laboratory assistant, mechanical test engineer, sales engineer, research engineer heading Continental's mechanical laboratory, and has been recently promoted to be assistant manager of the sales engineering division.

His work in the Mid-Continent Section has also been diversified. He has at various times served as vice-chairman of aviation, program chairman, and secretary of the Section.

"Enie" is not only an automotive enthusiast but is also actively interested in aviation. He holds a private pilot's license, and during the war did a good deal of work in the civilian air patrol. His other hobbies include hunting and golf, at both of which he is considerably better than a duffer. – by Harold Quigg, Field Editor.

employing an electronic system for ignition, Mr. Hartzell indicated that it would be more expensive because of the relatively large number of additional parts required and the skilled personnel required to service it. The electronic system provides timed pulses at regular intervals through the action of a switch capable of handling much more current than contact points can. The voltage reaches a peak in about 0.2 micro-seconds, compared to 100 micro-seconds for the present system. The plug gaps have to be doubled.

Mr. Hartzell stated that the cathode-ray oscilloscope shows that there is nothing to the story about the condenser kicking back and causing high voltage. However, a bigger condenser should be used if better low-speed performance is desired. The coils should always be connected so the first pulse is negative, since this takes less voltage. He pointed out that different plugs may require different voltages.

In conclusion, the speaker showed several interesting pictures of oscillograms of ignition system characteristics taken in an automobile while driving around.

Predicts Important Role For Synthetic Rubbers

By J. H. MACPHERSON, Field Editor

NORTHERN CALIFORNIA Section, Sept. 10—Virtues and drawbacks of various synthetic rubbers were outlined by J. J. Robson in a paper entitled "Heavy Duty Tires – Past, Present and Future Design and Performance." Fourteen years' experience in tire development work were supplemented by four active years in synthetic rubber tire development for the U. S. Army, and Mr. Robson now is manager of the West Coast Manufacturers Sales Division of Firestone Tire and Rubber Co.

Synthetic rubber presently used in automotive tires, he reported, is Government Rubber Styrene. G.R.S. rubber has less resilience, thus will heat up more readily and operate at higher temperatures under the same operating conditions than natural rubber tires. Butyl synthetic rubber, another type, has practically no resilience but is excellent as material for inner tubes and rubber tubing, holding air ten times as well as crude rubber. Neoprene is good for tires at normal operating temperatures but becomes extremely brittle under cold operating conditions.

Considerable difficulty was encountered from abrasion and cracking in the initial phases of development, when tires were 100% synthetic. Stripping of treads from casings was eliminated by including some natural rubber in the tires to provide a good bond between tread and casing. Even the more difficult problems encountered in large tire sizes were conquered rapidly, Mr. Robson reported, by the development of a combination of crude and synthetic rubber.

Present heavy-duty tires are constructed with 94% crude rubber and 6% synthetic, the latter for side walls. Butyl synthetic rubber is used for inner tube material.

He believes future tires will be made of synthetic rubber which is much superior to crude rubber. He demonstrated models of new tire construction developments including the Firestone wire cord tire, stronger than cotton, rayon or nylon cord, permitting a thinner casing, and cooler casing and tread operation. He expects larger diameter tires – perhaps a 24 in. diameter tire with a 21 in. depth. Legal limitation will of course limit future development, but may be modified to permit heavier, more rapid truck transportation.

Supersonic Flight to Moon Thought Possible

By R. J. MARBLE, Field Editor

BUFFALO Section, Sept. 13.—Contact with the moon in the near future was forecast by C. C. Furnas. Discussing supersonic flight and its problems of propulsion, stability, and guidance, Dr. Furnas, who is director of Cornell Aeronautical Laboratory, reported that present knowledge of pilotless aircraft makes it possible to launch a ship from one part of the earth to almost any other part . . . and the moon is well within the realm of possibility.

Germany's progress in the development of flying missiles and jet-propelled planes was described at the same meeting by Lt. Kimberlin Kane, Air Document Division, Army Intelligence T2, Wright Field. Captured German movies showed launching techniques.

Canvassing of Section members for preferences about meeting dates and subjects has resulted in a realistic season program for Dayton Section, a program which includes several field trips.

Buffalo Section Speakers Kane and Furnas

Guided Missles Still Not Up to Dreams, Scientist Says

by A. M. WATSON, Acting Field Editor

SOUTHERN NEW ENGLAND Section, Oct. 2 – Push buttons for push button warfare are not yet here, Dr. H. Guyford Stever of M.I.T. declared at this meeting. Research on supersonic aerodynamics continues to march, but there is a stumbling block: intelligence devices are not yet available to supply sufficient accuracy.

In his paper, "The Future of Guided Missiles," Dr. Stever outlined qualifications of various types of guided missiles. Solid fuel types of rockets cannot be used, he said, because there is no control of power once combustion is begun. Combustion chamber temperatures still are prohibitive in liquid fuel types. Thermo jet engines must remain in the earth's atmosphere in order to consume fuel. Intermittent jet types are relatively efficient only in the region of about 400 to 500 mph and within a 100 to 200 mile range.

Best bet currently seems to be the ram jet engine, or "flying stove pipe" – comparatively simple in construction, with good range and speed.

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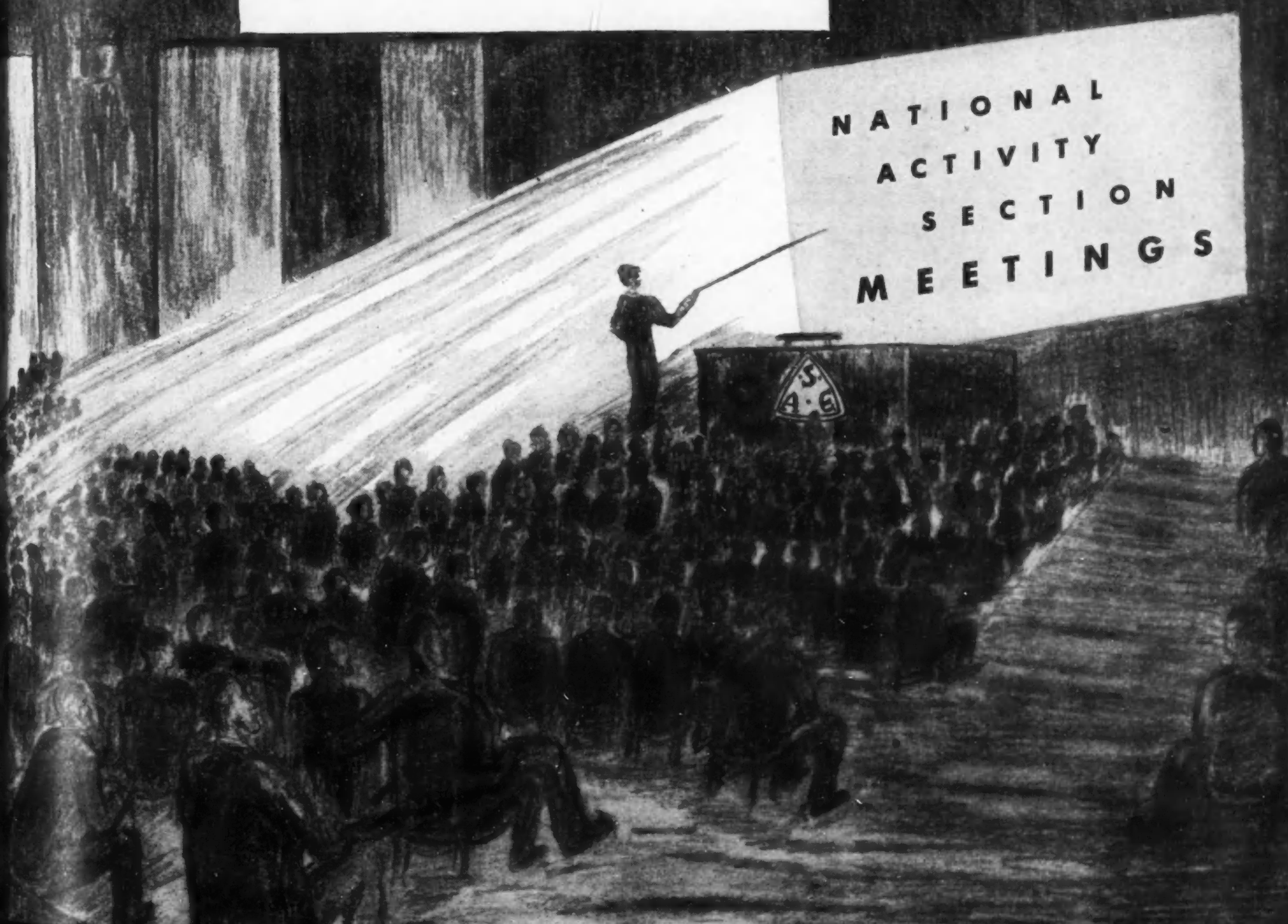
COMING S·A·E EVENTS

NATIONAL MEETINGS

MEETING	DATE	HOTEL & CITY
Fuels & Lubricants	Nov. 7-8	Mayo Tulsa
Air Transport Engineering	Dec. 2-4	Edgewater Beach Chicago
Annual	Jan. 6-10	Book-Cadillac Detroit
Aeronautic	April 9-11	New Yorker New York

(Details about meetings appear on following pages)



SAE National

AIR TRANSPORT ENGINEERING MEETING

DEC. 2-4 Edgewater Beach Hotel, Chicago

Program

MONDAY, DECEMBER 2

10:00 A.M.
C. E. Swanson, Chairman

This is Your Program
A. L. Morse, Aircraft Development Div., CAA Experimental Station

Liquid Cooled Engines for Transport Aircraft
J. D. Pearson and Eric Warlow-Davies, Rolls-Royce Ltd.

2:00 P.M.
J. G. Borger, Chairman

Method for Obtaining Optimum Aircraft Utilization – Domestic and Overseas
H. R. Harris, American Overseas Airlines, Inc.

Transatlantic Maintenance Problems from a European Viewpoint
K. H. Larsson, Aktiebolaget Aerotransport

8:00 P.M.
E. H. Sittner, Chairman

Engineering of Airports
Charles Froesch, Eastern Air Lines, Inc.

TUESDAY, DECEMBER 3

10:00 A.M.
W. C. Mentzer, Chairman

Passenger Aircraft Facilities – Design and Operation
A. P. Elebash, Pan American World Airways

Cargo and Passenger Problems As Applied to New Transports
E. S. Hamm, Northwest Airlines, Inc.

2:00 P.M.
Charles Froesch, Chairman

The Case of Flying Ground Equipment
W. L. Flinn, Capital Airlines

The Helicopter and its Relation to Air Transport Operations
Edward Nesbitt, Sikorsky Aircraft Div., United Aircraft Corp.

8:00 P.M.
Harold Hoekstra, Chairman

Landing and Launching of Transport Aircraft from Moving Land Vehicles
L. A. Rodert, National Advisory Committee for Aeronautics

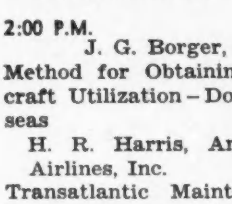
Application of Jet Assisted Takeoff to Transport Aircraft
E. E. Nelson, Aerojet Engineering Corp.

WEDNESDAY, DECEMBER 4

9:30 A.M.
A. L. Morse, Chairman

Under Wing Refueling
H. O. Olson, Douglas Aircraft Co., Inc.

BANQUET – 1:00 P.M.



H. R. Harris
Toastmaster

"A Quantitative Approach to All-Weather Flying," by W. E. Rhoades, Air Transport Association, and George Comstock, Airborne Instruments Laboratory, Inc. Presented by Mr. Rhoades

SAE President L. Ray Buckendale

ANNUAL MEETING

ANNUAL Meeting plans for 1947 indicate a 40% increase in papers over 1946, a sign of growing SAE vigor.

NEVER before in SAE history have your Meetings Committees developed such a wide range of technical events.

NOW the outline of Jan. 6 to 10, 1947, looks like 31 full-scale sessions at the Book-Cadillac Hotel, in Detroit.

UNUSUAL emphasis has been put on "things of tomorrow" in the choice of subjects made by your meetings committees.

AERONAUTICS, in line with the trend in recent years, will need 11 Sessions for those three SAE Activities.

LIGHT weight in the car of the future will headline one of three Passenger Car Sessions scheduled.

MATERIALS continue to play an important part in SAE Meetings. Metallic and Non-Metallic Sessions are planned.

EAGER truck and bus engineers will peer into future design. Higher output powerplants will be topic of one event.

EARLY in SAE history the transportation and maintenance engineers found T&M sessions vitally interesting.

TWO T&M Sessions have been scheduled for the 1947 SAE Annual Meeting. Lively discussions are freely predicted.

INSTRUMENTATION will be the subject of one of three Fuels & Lubricants Sessions. The two others will be stellar.

NEW ideas in body design will be outlined. One of two Sessions will show what streamlining has done for race cars, boats.

GREAT advances in Production thinking, Diesel engine progress, and what is new in Tractors will round out the largest and most interesting SAE Annual Meeting ever staged. Jan. 6 to 10, Book-Cadillac Hotel, Detroit.

Meetings Task Taps Whole SAE

NATIONAL meetings of the SAE are planned by the 11 professional Activity Committees, and the Engineering Materials Meetings Committee. Meetings committee chairmen of the 30 SAE Sections are also members of the Meetings Committee.

Thus the whole range of engineering interests of members of the Society, as well as geographical representation, is considered in planning SAE National Meetings.

Serving as members-at-large with Chairman Ralph R. Teetor of the Meetings Committee are Vice-Chairman John G. Wood, Gavin W. Laurie, and William Littlewood. The 12 chairmen of the specialized engineering groups, together with the 30 Section meetings committee chairmen, complete the committee personnel.

Many of the Activities plan their own special national meetings, besides contributing papers, speakers, and session chairmen to the Annual or Summer meetings, or both.

Planning national meetings has always been one of the most important functions of the Society during its 40-year history. Number of national meetings and papers has shown a huge increase in recent years, causing the Meetings Committee difficulty in arranging programs.

CALENDAR of Section Meetings

Baltimore – Nov. 14

Engineers Club; dinner 7:00 p.m. Speaker and subject to be announced.

British Columbia Group – Nov. 6

Georgia Hotel, Vancouver; dinner 7:00 p.m. High-Speed Two-Cycle Engines in Power Saws – Fred Davidson.

Buffalo – Nov. 15

Westbrook Apartments; dinner 7:00 p.m. The Design and Development of the Gas Turbine – Clifford Lane, Fredric Flader, Inc. Stresses and Deformations of Rotating Wheels Under the Action of Temperature Gradients Thrust and Precessional Loads – Ray Krouse, Fredric Flader, Inc.

Chicago – Nov. 12 and 18

Nov. 12 – Knickerbocker Hotel; dinner 6:45 p.m. Powering the Car of the Future – A. T. Colwell, vice-president, Thompson Products, Inc.

Nov. 18 – LaSalle Hotel, South Bend; dinner 6:30 p.m. A Glance into the Future of the Diesel Engine – C. G. A. Rosen, director of research, Caterpillar Tractor Co.

Cincinnati – Nov. 11

Alms Hotel; dinner 6:30 p.m. The New Crosley Engine – Paul Klotch, chief engineer, Crosley Motors, Inc.

Cleveland – Nov. 15

Carter Hotel; dinner 6:30 p.m. Aeronautical meeting in connection with air show being held in Cleveland Nov. 15 to 23.

Detroit – Nov. 4 and 18

Nov. 4 – Horace H. Rackham Educational Memorial Building; dinner 6:30 p.m. Dinner speaker – Malcolm Bingay, Detroit Free Press. The Trolley Coach in the Modern Transit System – C. B. Guernsey, Marmon-Herrington Co. Gold Cup Races – C. S. Ricker, McGraw-Hill Publishing Co.

Nov. 18 – Horace H. Rackham Educational Memorial Building; meeting 8:00 p.m. Car Air Conditioning – T. C. Gleason, Chrysler Corp. Capacity of Fresh Air Automotive Heaters – V. E. Matulaitis, Eaton Mfg. Co.

Indiana – Nov. 14

Atlas Hotel; Indianapolis. Some Problems of Crankshaft Design for High-Speed Diesel Engines – Neville Reiners, Cummins Diesel Engine Co.

Metropolitan – Nov. 21

Pennsylvania Hotel, New York; meeting 7:45 p.m. Problems of New Tire and Rim Sizes. Speakers – R. B. Wuerfel, Chevrolet Motor Division, General Motors Corp.; W. S. Brink, Firestone Steel Products Co.; Thomas Goodyear, Goodyear Tire & Rubber Co.; G. D. Ford, Railway Express, representing Vehicle, Rim, Tire and Operator Manufacturers respectively. Chairman of Meeting – J. Howard Pile. Technical Chairman – J. F. Creamer.

Milwaukee – Nov. 1

Milwaukee Athletic Club; dinner 6:30 p.m. The Engineering, Design, Production and Application of the Briggs & Stratton Air-Cooled Engines – L. J. Lechtenberg, Briggs & Stratton Corp.

Northern California – Nov. 12

Engineers Club, San Francisco; dinner 6:15 p.m. Aircraft Landing Aids – Commander R. L. Champion, director of Landing Aids Experiment Station, and R. D. Kelly, superintendent of development, United Air Lines, Inc. Slides and Motion Picture Film.

Northwest – Nov. 1

Gowman Hotel, Seattle; dinner 7.00 p.m. Pacific Western Torquemaster Transmission for Logging Equipment – Paul E. Forsythe and Robert S. Langdon, Western Gear Works.

Oregon – Nov. 8

Imperial Hotel; dinner 6:30 p.m. Diesel Engines. Speaker to be announced.

Peoria – Nov. 25

Jefferson Hotel; dinner 6:30 p.m. Aircraft Engine Design – W. T. Bean, Jr., Continental Aviation and Engineering Corp.

Philadelphia – Nov. 13

Engineers Club; dinner 6:45 p.m. The Helicopter of Today and Its Use in Commerce and Industry – David G. Forman.

St. Louis – Nov. 12

Desert Hotel; dinner 6:30 p.m. Engine Maintenance – Errol J. Gay, Ethyl Corp.

Southern California – Nov. 14

Biltmore Hotel, Los Angeles; meeting 8:00 p.m. T & M Meeting. Operation and Maintenance of Heavy Duty Trucks on the West Coast – Gus Martin, fleet superintendent, Pacific Freight Lines. Technical Chairman – L. L. Beardslee.

Southern New England – Nov. 6

Bond Hotel, Hartford; dinner 6:45

p.m. Precision Grinding – Walter M. Smith, general sales manager, Bryant Chucking Grinder Co. Motion Picture – Tooling for Better Internal Grinding.

Twin City – Nov. 7

Curtis Hotel, Minneapolis; dinner 6:30 p.m. The Present Status of Atomic Energy – Dr. J. William Buchta, director of the University College, University of Minnesota.

Washington – Nov. 12

Twenty-Four Hundred Hotel; dinner 7:00 p.m. European Transportation Problems – H. H. Kelly, European Central Inland Transport Organization.

Wichita – Nov. 14

Broadview Hotel; dinner 6:45 p.m. Airplane Stability – Carrol Peirce, aerodynamist, Boeing Aircraft Corp. Motion Pictures.

Williamsport – Nov. 4

Swan's Restaurant; dinner 6:45 p.m. Strain Gages – C. H. Gibbons, Eddystone Division, Baldwin Locomotive Works. Particular reference to the bonded resistance wire gage SR 4.

CFR Birthday

cont. from p. 96

Thomas J. Litle, Henry M. Crane, and E. P. Warner, and also the work of F. S. Tice, J. O. Eisinger, T. S. Sligh, Jr., Stanwood W. Sparrow, the late Dr. Thomas Midgley, Dr. Graham Edgar, Prof. Daniel Roesch, T. A. Boyd, Dr. J. Bennett Hill, Neil MacCoull, C. B. Veal, formerly SAE research manager and now manager of CRC, A. M. Rothrock, Cearcy D. Miller, and Lloyd Withrow. Many of these names were mentioned several times, and he mentioned that the milestones had not been erected by these men alone but with the cooperation of hundreds who did countless hours of tedious laboratory work in advancing the frontiers of petroleum technology and automotive development. He modestly glossed over the numerous contributions bearing his name during the past quarter century.

Dr. Wilson posed these problems as the major projects facing the CFR, and noted the large number of younger men who will be responsible for carrying on the work. They were: vapor lock, effects of sulfur in gasoline, inlet valve burning, further evaluation of knocking effects in automobile engines, relation between volatility and engine performance, and factors influencing engine sludge development.

Members of the CFR Interim Committee, which planned the anniversary dinner, were Mr. Davis, CFR Sponsor director; T. B. Rendel, chairman, CFR; B. B. Bachman, chairman, CFR Non-Petroleum Fuels Division; J. M. Campbell, chairman, CFR Motor Fuels Division; R. E. Ellis, chairman, CFR Aviation Fuels Division; Gordon Murphy, chairman, CFR Diesel Fuels Division; and C. B. Veal, secretary.

New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Sept. 10, 1946, and Oct. 10, 1946.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

British Columbia Group: Arthur Armstrong (A), Frank Davison (A), Burdette Trout (A), Clarence H. Willis (A).

Buffalo Section: William R. Green (M), Clifford J. Lane (M), William Stewart (A).

Canadian Section: L. F. Barnes (A), E. T. Miles Barratt (A), Arthur Stewart Bayne (A), Stewart Bowman (M), James R. Clerke (A), Raymond J.

Dean (M), John T. Easton (A), Howard C. Glunz (A), Alex L. Gray (A), Ivan Forbes MacRae (M), A. Lawrence North (A), F. R. Stephens (M), Lawrence Torgis (J).

Chicago Section: Stanley R. Brodhead (J), Austin E. Carlin (A), George J. Derrig (J), Raymond M. Houston (A), C. A. Richards (A), Fred A. Robbins (J), Eugene C. Sutton (A), John W. Trimble (A).

Cincinnati Section: William L. Mappes (A).

Cleveland Section: Clifford Harry Allen (J), Wiser Brown (M), Theodore N. Busch (J), Lester C. Corrington (SM), Wilbur E. Crink (M), Arthur E. Dekome (A), Myron L. Harries (SM), Charles M. Kitson (M), John L. Menrath (J), John L. Mueller (M), Charles W. Ohly (M), John D. Peace, Jr. (A), William Frederick Perkins (M), Lowell O. Ray (A), Albert O. Ross (J), Ernest H. Schanzlin (J), Steve A. Schneider (A), Robert E. Schwary (J), Ralph S. Shogren (J).

Colorado Group: Bernard J. Uhlir (A).

Detroit Section: Arthur W. Bull (M), William L. Casterline (A), Walter A. Clouser (A), Kenneth E. Coppock (M), William M. Duckwitz (M), Allen F. Edwards, Jr. (M), John G. Else (J), R. Dean Engle (J), E. Edwin Ensign (M), Capt. G. H. Esch (SM), John W. Fleischer (A), Fred E. Fricke (M), Alfred G. Gorski (J), Hugh William Harris (A), Frederick L. Hoelzel (A), Sam C. Hunt (J), Walter A. Jensen (M), Albert H. Kain (SM), T. James Levell (M), Charles James Murray Mason (FM), Joseph H. McCann (J), James R. McCordic (M), James W. McGuffey (J), Ensign Merle Wayne McLaughlin (J), J. Raleigh Nagle (SM), Robert C. Ofenstein (M), John James O'Malley (J), Fred L. Sage, Jr. (M), Victor Samson (A), John F. Sloan (A), Richard C. Spooner (A), Walter Eugene Swigart (J), A. K. Tice (A), Robert Brewster Webber (J), James E. Wilson (M), William F. Zack (SM).

Hawaii Section: Elmer Richard Bolles (M), Chew Chung (A), Howard Blanchard Case (J), N. R. Dawley (M), J. T. Elliott, Jr. (A), Lynott B. Root (A), W. P. Sheehan (A), Chas. J. Weaver (A), Robert S. Wilson (A).

Indiana Section: Howard Alton Ellar (J).

Kansas City Section: John P. Dranek (A).

Metropolitan Section: Otto Bernhard (M), Fred O. Black, Jr. (J), Thomas John Dooling (A), Walter J. Doran (J), Harvey H. Earl (M), James Eldora (A), Theodore R. Gladstone (J), Harry J. Graham (J), Paul A. Harter (J), Heaton Bennet Heffelfinger (M), Ralph E. Hensley (M), Capt. Frank W. Hogan, A.C. (A), Ralph Hopkins (M), Robert B. Lane (J), Edward Harold LeTourneau (M), Leight K. Lydecker (A), Lt. Comdr. Robert D. Mellen (M), George Washington Morrison (A), Frank N. W. Moy (J), William Joseph Murray (J), John James O'Donnell (A), Roy H. Olson (J), Daniel S. Orcutt (A), George Plevritis (J), Salvatore C. Provenzano (J), Bruno C. Reciputi (M), Edward Duer Reeves (M), Lt. Col. James A. Richardson, III (SM), Joseph M. Sills (M), Manuel Stillerman (J), Dunlop Taylor (A), George William Taylor (M), John Marshall Teague (A), Gerald Addison Tobey (J), Wm. R. Toeplitz (M), Serge Trey (M), Theodore Vandervliet (A), Frank T. Ward (M), Orrin J. Whitney (A), John J. Witmer, Jr. (J), Charles Francis Wunderlin (J).

Milwaukee Section: Joseph J. Alioto (J), Robert Ewald Hoffmann (J), Edward B. Lanman, III (M), Alain M. Madle (M), James E. Martin (A), George L. Smith (M).

Mohawk-Hudson Group: Wesley C. Baylis (M), Mrs. Dorothy M. Shackelford (J), Edmund H. Turnau (A).

New England Section: Jesse R. Boyle (A), Walter W. Gleason (J), Baird W. Hodgkinson (J), Daniel Howland (J).

Northern California Section: Henry Elmer Brink (J), Gerald I. Clark (M), Lt. Comdr. Dale Denham (J), H. F. Galindo (M), John H. Ritter (M).

Northwest Section: Albert O. Hinsch (A), Lewis G. Newlee (A), Roy O. Reime (A), Joseph W. Tubbs (A).

Oregon Section: Vincent W. Eckel (M), Joseph L. Guthrie (J), Edward E. Johnson (A), John S. Larison (A), Edward Neubauer (A).

Peoria Section: Charles F. Elder (A), John G. Findeisen (M), James C. Porter (J).

Philadelphia Section: George Edwards Agnew (M), Robert T. Elliott (M), S. F. Niness (M), Leslie John Trigg (J), S. R. Zimmerman, Jr. (A), Thomas M. Zimmerman (A).

Pittsburgh Section: Court L. Wolfe (J).

St. Louis Section: Carroll K. Bransford (SM), Paris W. Phipps (M), W. S. Rigby (M).

Southern California Section: Theron F. Brown (M), Willard W. Comstock (A), D. Des Lauriers (A), James L. Dooley (J), Melvin Fisk (J), Joe Boucher Hartley (J), Clark Hickerson (A), Capt. James D. Hoffman (J), Galen A. Holcomb (A), Houston C. Hunt (A), Elmer A. Johnson (A), Russell William Lamb (A), Monroe Seymour Levy (J), Donald B. MacKay (M), Walter Osborne (A), Waldo A. Runner (J), Glenn G. Shafer (J), O. B. Shaw (A), William Beal Shaw (A), James Stronach Stoker (A), Myron Tribus (J), Tom Urban (A), Walter Van Voorhees (J), Frank O. Warmuth (A), F. B. Wasserboehr (A), William Douglas Wilmott (A), Roy Wright (A).

Southern New England Section: Edwin A. Pecker (J), Stephen M. Truex (J), Norman Wigney (A).

Spokane Group: Jerry C. Barker (M), Ray A. Wager (A).

Syracuse Section: Alfred P. Gallauresi (J), Richard W. Stewart (J), Richard D. Williams (J).

Texas Section: Melvin B. McCracken (M).

Twin City Section: Lewis S. Plett (M).

Virginia Group: Sam Greenberg (A), Harold Norweed Tyler, Jr. (J), Oscar S. Ward (A), Charles Hamilton Woodward, Jr. (A).

Washington Section: Lt.-Col. William Fowler Duncan (A), Major Ronald Mogford (A).

Western Michigan Section: George E. Dake, Jr. (J), Alvin L. Maring (J).

Wichita Section: J. W. Lancaster (J).

Williamsport Group: Philip Hubert Walker (J).

Outside of Section Territory: Lt. (jg) H. W. Johnstone (A), Berton A. Purdy (M), Wilmoth S. Respess (M), W. P. Sims (A), Thomas Eric Swann (A), Leo F. Swoboda (M), Edward B. Van Voorhees (J).

Foreign: Leslie F. Atkinson (FM), England; Capt. John Cedric Coates (A), England; Gaetan de Coye de Castelet (FM), France; Michael Bruce Urquhart Dewar (FM), England; Enver Eke (J), England; Gustaf Gudmundson (FM), Sweden; Stanley Bertram Hartshorne (J), England; Dr. Henry Hirst (FM), Australia; Arthur Shepherd Hukin (J), England; Kenneth William Lenton (FM), England; James Hector MacDonald (FM), India; Albert Edward Palmer (FM), England; Jan Soeten (A), Holland; Max Troesch (FM), Switzerland; Edward Turner (FM), England; Frank Nesbit Wright (FM), Australia.

Applications Received

The applications for membership received between Sept. 10, 1946, and Oct. 10, 1946, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section: John Perry Barker, Howard Charles Brown, Edward J. Jankovic, Frank S. Moomey.

British Columbia Group: Arthur Douglas Savage, James Irving.

Buffalo Section: John C. Flor, John Edward Hammond, Robert William Morgan, Carl G. Pedersen, James W. Westphall.

Canadian Section: Donald B. Barry, George Rex Fletcher, Vaughan E. Ireland, Gelb Leslie, Elmo C. Maunder, William P. Payne.

Chicago Section: Charles E. Capron, Michael P. deBlumenthal, David P. Eastman, Edward J. Emond, Herdis G. English, Ford D. Johnson, John G. Marshall, Lawrence Patrick McCarthy, Howard A. Offers, I. F. Richarson, Walden P. Weaver.

Cincinnati Section: William J. Brinkman.

Cleveland Section: William D. Angst, Jack Beavis, Thomas John Boastfield, Vincent Ellis, Charles MacKenzie Fluke, Stanley L. Gendler, Frank L. Mills, Alexander Andrew James Papp, Jr., Elmer Van Sickle, David J. Sloane, John Toma, Robert Phillip Wollery.

Dayton Section: Sylvan E. Connair, Jr.

Detroit Section: Robert L. Candlish, Robert Wayne Carr, George Chieger, David O. Davis, Wayne H. DeMoss, Ray C. Doebler, Wallace Winfield Edwards, John Emanuelsen, Roy E. Farmer, Louis F. Fisher, Clinton S. Fulton, John Lee Gilmour, Merrill A. Hayden, Edward V. Hindle, Jerry M. Gruitch, Kenneth M. Koch, William Louis Komph, Charles T. Langley, James A. Line, William E. McCravey, N. Robert McManus, Carl A. Nystrom, Albert August Rouse, John D. Shaw, Ray E. Spokes, Donald O. Stovall, Cleveland Walcutt, Jr., Charles O. Weisenbach, Rolla V. Wright.

Hawaii Section: William S. Holloway, Arthur G. Kruse, Arthur David Stubenberg.

Indiana Section: Sterling Kenneth Keyser.

Kansas City Section: Louis R. Koepnick, Frederick V. Oliney.

Metropolitan Section: Walter C. Alexander, Maurice Benton, Harrison W. Burton, Franz Campolmi, Joseph Edwin Carlton, Howard Russell Dentz, Jr., Frank William Farrelly, Joseph P. Fay, Vivian Ruth Goff, John C. Hollis, Mark Knapp, Edward W. Koffman, Herbert Robert Kornblum, Robert Stanley Krinsky, Joseph Leonard McGinniss, Grace Eileen Musker, Thomas Hart Odell Newman, S. Edmund Nichols, William H. Oetjen, Anthony E. Robertson, George Robert Sergeant, Jr., Simon Soto, Andrew A. Vizzi, Henry A. Waller, O. S. Williams, Jr., Nicholas Dionisyos Yuelys.

Milwaukee Section: Elmer William Bernitt, Donald C. Galbraith, Harry F. Minnick, Earl L. Monson, C. Frank Pervier, L. H. Schoenleber, Guy Scrivner, Otto A. Uyehara.

New England Section: Capt. Arthur L. Daun, Arthur S. Harvey, Denham G. Jaycock, George M. Schutter, Lewis K. Scott, Jr., J. Roy Smith.

Northern California Section: Warren S. Enochian, Thomas R. Hare, Stanley R. Piaggi.

Northwest Section: James Carroll Stuart.

Oregon Section: Henry Muessig, Dan Santry.

Peoria Section: Lawrence L. Brown, Merle W. Dargel, Robert S. Mills.

Philadelphia Section: Hyde W. Ballard, Gregory C. Meyer, G. Jason Sawyer.

Pittsburgh Section: Elmer W. Schink.

Salt Lake City Group: L. Clair Williamsen.

Southern California Section: Walter Bennett, Robert E. Day, Charles F. Derbyshire, Chester J. Dunn, George Henry Eckels, Edward Robert Elko, Wilfred Camphadis Gibson, Arthur Adelbert Mathewson, Jr., William James McClure, Terry M. Prudden, Edward Tische, LeGrande W. Whitman.

Southern New England Section: Guy E. Beardsley, Jr., Allen L. Brownlee, John Ekizian, Richard T. Hicks, William Paul Perrigard, Frederick Joseph Pommer, Paul John Rich, Daniel E Shapiro.

Spokane Group: Harold C. Besgrove.

Syracuse Section: John William Harrington, Wilbert R. R. Winans.

Texas Section: Lt. (j.g.) James T Herlihy, Joseph Robert McGonigle.

Twin City Section: Nels E. Erickson.

Virginia Group: Howard Ira Minson.

Washington Section: Robert P. Carroll, Marion MacKenzie Taylor.

Western Michigan Section: Ronald E. Wood.

Wichita Section: Eugene O. Clay, Marle Francis Jackson, R. H. Willey.

Williamsport Group: Emilio Frasca, R. P. Graham, Sidney John Kelly.

Outside of Section Territory: William F. Broker, Raul B. Carpio, Kenneth S. Guhman, John P. Todd, Wendell P. Turner, Huston Gilbert Welch.

Foreign: David Stuart Blackmore, England; Anthony Eskrigg Cooke, England; W. Leslie Cuthbert, Trinidad; Mohammed Ibrahim Fawzi, Egypt; Oliver Dennis Gibbon, Trinidad; Henry Herbert Hammond, India; Frank Stanley Lester, England.

Personal Planes

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used wherever possible. While it increases weight, it reduces cost and service troubles.

Maintenance and manufacturing costs have been given careful consideration in the design of this engine. Analyses show that it can be produced at competitive prices. (Paper entitled "Investigation of an Opposed-Piston Light Aircraft Engine" presented at the SAE National Aeronautic (Spring) Meeting, April 4, 1946.)

Sees Cheaper Plane In Radical Design

Digest of paper

By B. F. RAYNES

Rohr Aircraft Corp.

AN unorthodox approach to light plane design as represented by the Rohr M.O.-1 is advanced by Mr. Raynes as a step in the right direction to the safer and cheaper personal plane. In describing this model, he points out that:

It is a 2-place 2-control ship with retractable tricycle landing gear and a pusher propeller. An engine-driven

blower draws in air from slots around the fuselage and forces this air across the engine and through the fuselage into the wings.

The air-tight wings act as ducts to transmit air under pressure to full span slots located on the upper surface. The variable-pitch propeller and blower are mounted on a common shaft. In the event of power failure, the propeller is used as a windmill and operates the blower.

The boundary layer about the wing is controlled by an air orifice leading to the wing. This maintains lateral control at high lift coefficients, produces favorable yawing moments, and reduces the profile drag coefficient.

The conventional aileron system is unable to develop sufficient rolling moment at low speeds, produces adverse yawing moment, and is likely to produce a stalled condition over the down aileron wing area. The M.O.-1 lateral control system produces higher rolling moments at low speeds than at high speeds. Favorable yawing moment is obtained by a differential jet effect.

High maximum lift coefficients permit low landing speed without large wing areas with disadvantages in the high speed range and increased production costs. The small wings on the M.O.-1 simplify storage and handling problems.

A quiet airplane has not as yet been made; but efforts were made to keep noise and vibration in this plane to a minimum. Placing the engine and propeller aft of the passenger compartment makes noise from this source less obnoxious. A tractor propeller produces turbulence in its wake causing vibration and drumming of light plexiglas and sheet metal portions of the fuselage surrounding the passenger compartment. This is eliminated with a pusher installation.

A general utility personal airplane must in some measure compete with airline travel as regards speed. Cruising speeds of 200 to 300 mph are much more desirable than present limits of 110 to 140 mph. To attain higher speeds, the fuselage was designed to keep its drag to a minimum.

A large number of slots are provided completely around the fuselage aft portion through which the boundary layer is drawn. This system has two advantages. Firstly, the air taken in has been accelerated by surface friction to nearly the speed of flight and requires no additional energy to accelerate to the speed of flight. Secondly, drawing off the boundary layer around the complete fuselage permits use of a smaller finess ratio with a resultant drag reduction.

Empty weight of this airplane – 495 lb – reflects simplicity and structural economy of the basic design, an important cost-reducing factor.

We must face unpleasant facts and realize that present personal planes – including the M.O.-1 – are noisy, vibrating, and unsatisfactory devices designed to transport people from one place to another with less safety and at greater expense than any other form of transportation. Designers must have the courage and ability to solve a multitude of difficult problems; management must supply the foresight and initiative to carry out extensive development programs. (Paper entitled "Light Plane Design Criteria" presented at the SAE San Diego Division, June 6, 1946.)

Two Control Plane Is Simple Yet Safe

Digest of paper

By J. M. GWINN, JR.
Consolidated Vultee Aircraft Corp.

PRINCIPAL difficulty with the present light plane control system is that it makes skill a requirement for safety. The dying tradition of aviation heroism, plus the trend of flying for the many, makes development of the 2-control airplane of paramount importance

to the industry, says Mr. Gwinn. He points out that:

What really makes skill a requirement for safe flying are the six degrees of motion obtainable in an airplane. These motions are translation vertically, laterally and longitudinally and rotation about the vertical, lateral and longitudinal axis. By comparison the automobile has but two degrees of freedom, the other four motions being restrained by the physical nature of the highway.

Major hazard with the six motions is that the airplane may move in a direction other than which it points. Added to the general problem are the complexities of the control system which comprises the elevator, aileron, rudder, and throttle.

Simplifying Motions

Solution of the control problem requires a reduction in the complexity of control by eliminating unnecessary combinations of motion. Simplest conception is an airplane that goes in the direction pointed so that the plane is spinproof and stallproof. This produces three degrees of freedom – turning, change in elevation, and change in speed.

This arrangement is quite satisfactory in the air, but creates difficulties in landing and take-off. In wind the airplane does not glide in the direction pointed. Also in landing the airplane does not point in the direction traveled relative to the ground due to cross wind. Assuming the pilot develops sufficiently good judgment of glide, he will collide with the ground nose down if he does not develop depth perception. This is the most hazardous type of accident. Passenger casualties are high because they are thrown against the structure ahead of them.

Criterion Two Controls

The airplane that goes in the direction pointed, therefore, must be changed to one that goes in the direction pointed laterally, but is substantially level longitudinally at all times. Such a plane can be developed with but two controls – an elevator and aileron.

It should have a tricycle landing gear meeting these requirements:

1. Steerable front wheel operated by aileron control;
2. Rear-wheel brakes operated by a single brake pedal;
3. Large rolling radius on front wheel;
4. Zero aerodynamic directional stability around rear wheels;
5. Sufficient shock absorption to permit landing without flare.

To be stallproof the light airplane must have:

1. Restricted elevator control at maximum C1;
2. Small c.g. travel;
3. High longitudinal stability;
4. High damping in pitch;
5. Low moment of inertia in pitch.

Spinproof characteristics can be attained by:

1. No independent control in yaw;
2. Low moment of inertia around all axes;
3. Principal axis of inertia in roll at a substantial negative angle to zero wing lift;
4. Heavy damping in yaw;
5. Not too great directional stability;
6. Satisfactory lateral control at stall;
7. Propeller located so there are no unsymmetrical fin areas within the slipstream.

By omitting the rudder and rudder controls, a 2-control plane of this type can be produced at less cost than a conventional aircraft. (Paper entitled "The Application of 'Two-Control' Systems for Light Aircraft," presented at the SAE San Diego Division, June 6, 1946.)

Aero Meeting

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pelled Military Aircraft" by H. J. Wood, Project Engineer, Airesearch Mfg. Co. This paper dealt primarily with the problem of keeping the pilot's cockpit of the P-80 cool enough for tactical operations, and without too great a drag penalty. Various heat exchange systems were compared; the "bootstrap," "regenerative," "reduced ambient" and "shoestring" all being compared to the "simple" system, which is the only one now flying so far as the author knew. All contemplate use of the Airesearch expansion turbine refrigeration unit for cooling. Studies made to date indicate that the regenerative system will prove more efficient at speeds of more than 900 mph. This paper stimulated lively discussion. Messinger, of Lockheed, felt that the "bootstrap" system was probably best for both the P-80 and Constellation. The problem of air stratification in a small cockpit such as that of the P-80 was admittedly troublesome, as was the humidity and condensation which is being experienced. There is real need for a satisfactory water separator.

A fine detail study on the sensitivity of the human body to vibration was presented by Stanley Lippert, Douglas, in the paper "Human Response to Vertical Vibration." Precise parameters were shown for six classifications of human reaction to vibrations of varying amplitude and frequency.

A long step in the direction of space ships was indicated in the report on "High Altitude Performance of Aircraft Electrical Equipment" by Harry H. Howell, Boeing Aircraft Co., which detailed exhaustive research conducted in many hours of high altitude flight testing in B-29 type aircraft operating as high as 40,000 ft. Considerable progress was reported though no final solution is yet in sight for the difficulties encountered with generator brushes at very high altitudes.

Another attack on the altitude problem, from the standpoint of engine ignition, was reported in the paper "Low Tension Ignition – A System of Merit" by John K. Rudd, project engineer, Wright Aeronautical Corp. Many advantages of the low tension ignition system were outlined and the presentation was supported by comments from the floor volunteered by W. J. Spengler, of Scintilla Magneto Co., who gave further information on the development of low tension ignition systems.

Development of a 28-24 volt direct-current electrical system for the DC-6 was described by Marsden H. Peairs, Douglas, in the paper "Design of a Transport Airplane Electrical System." Peairs forecast greater future reliance on electrical systems for actuation of transport aircraft auxiliary equipment.

One of the very interesting sessions was that of Thursday evening at which A. Lewis MacClain, former Army flier and civilian test pilot, and now engine installation liaison engineer for Pratt & Whitney, read a paper titled "Factors Producing Erratic Engine Operation." The speaker increased the value of his written paper by his impressive knowledge of the subject and his informal delivery. He wove together the many variables of engine operation into a cohesive pattern of interest and significance but the many factors tending to mitigate against smooth operation were so well brought out that one spectator was heard to murmur, "This is the best argument for jet engines I've ever heard."

"The Future of Automatic Power Controls" by G. W. Newton and W. K. Klose, Boeing Aircraft Co., outlined a proposed instrument panel simplification, but even the simplification proposal seemed so complex by comparison with jet engine controls that it was one more indication of the trend to jets.

Possibility of more than doubling aircraft engine piston ring life was suggested in the paper "Development of Chrome Plated Piston Rings for Air-

craft Engines" by John B. Minnich, Wright Aeronautical Corp.

Development of a war emergency measure which was never actually used in tactical operations and now may find its chief application in the field of jet engines was outlined in "Oxygen Boost for Engine Power at Altitude" by Francis Masi, Naval Air Material Center; Ernest F. Fiock, National Bureau of Standards; and Robert A. Grosselfinger, DeLaval Steam Turbine Co. Through use of a system weighing a total of 180 lb it was found possible to increase the output of the R-2800 engine by 300 brake horsepower for a period of 16 min by feeding liquid oxygen into the engine cylinders. Water injection was used to reduce head temperatures resulting from the augmented power output.

Production Meeting

cont. from p. 20

meeting on the important role of the engineer in budgetary controls and methods improvements in manufacturing organizations.

E. F. Gibian, chief industrial engineer of Thompson Products, Inc., presented for the first time a complete program and outlined the functions of the industrial engineer's staff of his company. It stimulated production engineers in discussing in considerable detail this vital management tool.

He decried the conventional standards as expressed in terms of "average" workman, or "normal" output as meaningless. "The level of 100% performance of a skilled operator is the only adequate yardstick," he said. He warned against holding a standard permanent, however. After it has been determined by time studies, it should always be subject to review, he said.

After defining his conception of machine, direct material, expenses, and scrap and spoilage standards, Mr. Gibian explained the importance of job analyses evaluation. Kept within the boundaries of the company's general personnel structure, the industrial engineer must keep his own wage structure in the plant in equitable balance.

As chairman of the Cleveland Section, host to the meeting, Mr. Cox welcomed the members and guests, and introduced Toastmaster Hacker who handled the dinner session.

President Buckendale praised the work of the committee on arrangements, including members of the Cleveland Section's Governing Board, and explained the structure of the SAE Technical Board. He closed with a somber admonition to all engineers to consider the wider problem of today's industrial economics and the effects of these events on their lives.

Touching on points raised by Messrs. Buckendale, Weidman, and Gibian, as well as dozens of discussers at the

earlier technical sessions, Mr. Stilwell, the principal speaker of the evening, declared that willingness for the worker to work is the most essential element in production.

He cited recent spokesmen of the Government and labor who, belatedly he pointed out, have come to see – or at least to give lip service to – this fact.

But labor's long drive, supported by Washington, for limited production plus successive wage increases, has held supply down and forced prices up – thus defeating the purposes of the wage rises.

"For 14 years millions of Americans have been taught the false economy of 'cradle-to-the-grave security'," Mr. Stilwell said. Millions of young men and women have been taught nothing else, and do not realize that real economic security can be achieved only through their own work," he continued.

"You production engineers who are on your way up to the top in management during the next 10 or 15 years must look this situation straight in the face. It is a gigantic job of re-education, but it has become an absolute 'must.'

"The job cannot be done by preachment. It certainly must not be attempted through coercion. It can be accomplished only through experiment.

"Until industry is granted equality with labor under the law," he continued, "and the road blocks set against management have been cleared away, I predict that you men won't live long enough to see industrial production again in America."

■ ■ ■

cont. from p. 100

Explains Source of New Studebaker Design

by C. K. TAYLOR, Field Editor

INDIANA Section, Oct. 10 – Two principal factors determined the design of new Studebakers: time element, and belief that the public was ready for extensive style changes.

Studebaker's A. G. Laas reminded this meeting that thought and ideas and even experimentation continued during the war years. Aircraft design was studied for its characteristics of better visibility, increased comfort, and functionability. Attempt was made to give the public a car neither radical nor severe, but generous in visibility, room, and good riding qualities.

Plastics Field Widened By Extensive Research

By JAMES E. P. Sullivan, Field Editor

DAYTON Section, Sept. 17—The average American will find more and more plastics in his life as time goes on, according to H. K. Nason, Development Director of Monsanto Chemical Co. His talk on "Functional Use of Plastics in Automotive and Aircraft Applications" revealed that:

• The material situation for plastics is no worse than that faced by other industries.

• Plastics applications in the automotive and aircraft fields are innumerable: synthetic water-repellent, flame-proofed fabrics for interior use; impregnated and laminated panels; finishes for metals; knobs; instruments; batteries; radios; bearings; gears; propellers; fuel cells; and finishes for engine insides.

• "Bin-treatment" is dangerous: it is important to treat each proposed application for plastics as a distinctly individual case.

• A great deal of research and study lies before the plastics industry if the potentialities of the new materials are to be fully realized.

About SAE Members

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play there for the past five years.

RICHARD H. BURROUGHS, JR.

Richard H. Burroughs, Jr. was killed in an airplane crash on July 8. A graduate from both Princeton University and the Boeing School of Aeronautics, he had been with Vought-Sikorsky Aircraft, Stratford, Conn. during his entire engineering career.

His chief assignment was wind tunnel testing and related work in aerodynamics. He later devoted the major part of his time to flight test engineering.

VICTOR R. HEFTLER

Victor R. Heftler, a graduate of Ecole Polytechnique, France, died September 15, in Grosse Pointe Park, Mich. After distinguishing himself in engineering in his native country, he was elected president of the Zenith Carburetor Co., and joined the Society in 1912. He was a member of SIA, France, and the ASME. His career also included railroad and other civil engineering.

D. SULPRIZIO

D. Sulprizio, president and general manager of United Engine & Machine Co., San Leandro, died August 30, at his home.

A native of Italy he graduated from the Polytechnic School in Milan in mechanical engineering in 1906.

His early engineering was with Fiat and Tosi, a Milan manufacturer of electrical vehicles. He also worked in ship construction in Naples. Having been in this country for some time, he became a naturalized citizen in 1929 and specialized in design of several internal combustion engines, aluminum and alloy pistons and special machinery.

CHARLES H. McCREA

Charles H. McCrea, 56, president and director of National Malleable & Steel Castings Co., died suddenly August 24, after suffering a stroke in Cleveland.

Mr. McCrea, who had been president of the company since September, 1942, was born in Logansport, Ind., and was a graduate of Purdue University in 1912. He spent virtually his entire business career with National Malleable, joining the company in Toledo in 1913 as a special engineer. He was advanced through many promotions and served in various plants and sales offices, including sales work in many foreign countries.

In World War I he served as a captain and regimental adjutant. Mr. McCrea was considered an outstanding authority in the foundry industry, being a past trustee of the Malleable Founders Society and a member of the Steel Founders Society. He was a director of Interlake Iron Corp., and of the Railway Business Association.

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